BUFFALO
AIR HANDLING

Record Submittal

Thomas Engineering

BMS

Sales Order # 130079-01

Purchase Order # 129006

TCS41704A / AHU 00407

9/25/13

BUFFALO
AIR HANDLING

Buffalo Air Handling Contact Information

Buffalo Air Handling Factory:

Buffalo Air Handling
467 Zane Snead Drive
Amherst, VA 24521
Tel: (434) 946-7455
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BUFFALO
AIR HANDLING

TERMS AND CONDITIONS OF SALE

The following are the Standard Terms and Conditions of Sale of the Buffalo Air Handling Division of Air & Liquid Systems Corporation ("Seller").

1. **ACCEPTANCE OF SELLER'S TERMS AND CONDITIONS OF SALE.** Seller and Buyer agree that the following terms and conditions will apply to any order from Buyer accepted by Seller. No order or contract will be binding on Seller unless and until accepted, and acknowledged by Seller's office in Amherst, Virginia. Sales representatives are not authorized to bind Seller. No terms or conditions other than those stated herein, whether contained in Buyer's purchase order or shipping release or elsewhere, and no written or oral agreement that purports to vary these terms and conditions will be binding on Seller, unless hereafter set forth in writing and signed by an authorized officer of Seller. Buyer's assent to the terms and conditions set forth herein will be conclusively presumed from Buyer's receipt of this acknowledgement without prompt written objection or from Buyer's acceptance of all or any part of the equipment or material ordered.

2. **CHANGES**. Equipment changes by Buyer involving design and/ or drawing modifications, or after approval and release for manufacture, will result in an administrative charge, in addition to any price adjustment for the change, and may result in a delay of the scheduled shipping date.

3. **CANCELLATION CHARGES.** An order canceled prior to shipment will be subject to cancellation charges.

4. **INVOICING TERMS.** Payment terms: Net 30 days, with interest charges of 1.5% per month thereafter. All shipments will be subject to the approval of Seller's credit department. Quotations are subject to acceptance within 30 days from quotation date.

Seller will invoice, and payment will be due in accordance with the payment terms above, for : a) shipment of complete order; b) partial shipment of order; c) finished product or work in progress when any shipment delay is caused by Buyer for any reason including, but not limited to, change in requirements, components not received, rigging or staging not available, site not ready, etc. Seller will be entitled to reasonable storage charges for any such delay caused by Buyer.

5. **DELIVERY.** Seller will use its best efforts to deliver on a timely basis. Seller, however, will not guarantee or accept consequential losses associated with its inability to meet a specific time of day or specific date. FOB origin.

6. **ESCALATION TERMS.** Prices on equipment of Seller's manufacture are firm for shipments made within 6 months from date of purchase order; for shipments made beyond 6 months from date of purchase order, prices are protected for 6 months from any announced price increase occurring later than the date of the purchase order. Beyond that period, prices will be adjusted to Seller's prices at time of shipment with adjustment limited to 20% of the purchase order price. Contracts providing for escalation based on an index will be escalated from the date of purchase order to the date of shipment using 100% of the quoted price as the base. Prices on equipment not of Seller's manufacture are subject to adjustment to the prices in effect at the time of shipment.

7. **FORCE MAJEURE**. Neither party will be liable for any failure or delay in performance due to force majeure conditions, including, but not limited to, war, riot or civil disturbance, accident or equipment breakdown, strikes or disputes with employees, actions of any governmental authority, compliance with any law order, regulation or directive of any governmental authority, shortages of or inability to obtain materials, supplies, transportation, fuel or energy, or any cause beyond the reasonable control of Seller or Buyer, as the case may be.

8. **TAXES**. All taxes which Seller may be required to pay or collect under any existing or future laws with respect to the sale, purchase, delivery, storage, manufacture, processing, use, consumption or transportation of any equipment ordered by Buyer, including taxes upon or measured by receipts from sales (except net income and equity franchise taxes) will be for the account of Buyer.

9. **PATENTS**. If the equipment is to be manufactured in accordance with Seller's specifications. Seller agrees to defend any proceeding brought against Buyer on a claim that the equipment furnished to Buyer infringes any patent in the United States and Seller agrees to pay all direct and actual damages and costs awarded against Buyer in any such proceeding, provided that Seller is promptly notified in writing of any such proceeding and given authority, information and assistance for the defense thereof. If Buyer furnishes the specifications then Buyer shall hold Seller harmless against any such claim which arises out of compliance with specifications.

10. **NON-CONFORMANCE**. Seller will replace, at the original point of delivery, equipment or material which upon inspection before installation is found defective or not in conformity with the applicable specifications, provided that written notice has been given of such defect or non-conformity within 15 days of receipt of equipment by Buyer and Seller is given reasonable opportunity to inspect. No claims will be accepted by Seller for the cost of any labor expended on such equipment or material, or for any separate special indirect, incidental or consequential damages to anyone. If Buyer does not give such notice, the equipment or material shall be deemed to be in all respects in accordance with the specifications.

11. **BUYER'S EXCLUSIVE REMEDY; LIMITATION OF DAMAGES.** In case of an alleged breach, Seller's entire liability and Buyer's exclusive remedy shall be as follows:

In all situations involving the performance or non-performance of equipment, Buyer's remedy is (1) the adjustment or repair of the equipment or, at Seller's option, the replacement of the equipment or (2) if Seller is unable to repair the equipment or replace it with equipment in good working order, Buyer will be entitled to a refund or credit in the amount of purchase price paid by Buyer for the equipment.

Seller's liability for damages to Buyer for any cause whatsoever and regardless of the form of action or claim, whether in contract or in tort, including negligence, shall be limited to 110% of the purchase price of the equipment or part that is the subject matter of, or directly related to, the action or claim on which such liability is based. In no event will Seller be liable for any lost profits, lost savings or any special, indirect, incidental or consequential damages, even if Seller has been advised of the possibility of such damages, or for any claim by Buyer based on any third party claim, except as provided in the Section entitled **Patents**.

12. **DRAWINGS.** Unless otherwise stated in the quotation, prices include a set of customer interface contract drawings and service manuals. If additional drawings are needed or Buyer-initiated changes require additional drawings, they will be provided only upon receipt of a written order authorizing additional charges for such drawings.

WARRANTY

Seller warrants for a period not in excess of 18 months from date of shipment or 12 months from date of installation, whichever is earlier, the design, construction and materials of Seller's products to be free from defects in materials and workmanship. Seller's sole obligation and Buyer's exclusive remedy under this Warranty is limited to the repair or replacement without charge, f.o.b. Seller's factory, of any defective parts. Seller will not be responsible for damages of any nature, resulting from breach of the above stated Warranty or from any defect in Seller's products, either in materials, design, or construction, or arising from the use of such products. Seller does not guarantee against abrasion, corrosion or erosion.

The above stated warranty constitutes the only warranty made by Seller and is given expressly in lieu of all other warranties express or implied, including any implied warranties of merchantability or fitness for a particular purpose.

Warranties on equipment not of Seller's manufacture are limited to the terms of any warranties furnished by Seller's suppliers to the extent they may be made available to Buyer.

Thomas Engineering, Inc.
BMS

TCS41704A / AHU 00407

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Air Handling Unit Information

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Job Order: 13331 **Revision:** C

Data Sheets

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GENERAL

Customer:	Thomas Engineering, Inc., Hoffman Estates, IL	**Qty/Size/Type:**	1 2 BB2AI-DPFHCW6DHHCNO
End User:	BMS	**Sales Office:**	999 BAH - Home Office
Engineer:	Thomas Engineering, Inc. / Marty Berthold	**Sales Rep.:**	Jim Adamczak
Mark:	TCS41704A/AHU00407	**Project Mgr.:**	Dave Lewandowski
Cust. PO:	129006	**Designer:**	Ivan Johnson / Malcolm Childress

UNIT CONSTRUCTION

CASING: 2" Thick w/ 3 pcf density fiberglass insulation — **Design Pressure (+/-)** 12 inches W.G.

Roof: Flat — **Environment:** Indoor construction

Exterior: 0.063 In. Stucco Aluminum — **Fasteners:** Exterior Stainless steel Interior Stainless steel

Interior:	18	GA	304 Stainless Steel	-	Entire unit
Bulkhead:	16	GA	304 Stainless Steel	-	Single wall construction

Exterior Painted: No **Paint Finish:** **Color:**

Thermal Break Construction: Yes **Location:** Entire unit

Knockdown Construction: No **KD Type:**

Unit Installed On[1]: Housekeeping pad or building floor

[1] - *Provide level foundation under perimeter of each section.*

Insulation Type: Plain surfaced - Entire unit

BASE[2]: C8 x 11.5 lb/ft Steel Structural Polyurethane foam insul.*, 20 GA galv. steel coversheet & removable lifting lugs

Floor Sht.: 10 GA 304 Stainless steel - Entire unit except the cooling coil & humidifier sections

Floor sheets are stitch-welded and sealed with no turned-up perimeter lip.

Drain Pan: 16 GA IAQ continuously sloped 304 Stainless steel - Cooling coil & humidifier sections

Drain Pan Connection Hand: Right Hand -

[2] - *All black steel, including unit base, shall be painted w/ epoxy mastic.*

* - *Base assembly meets NFPA 90A per UL723*

DOORS[3]:

[3] - *Refer to main assembly drawing for door locations.*

Qty:	Size:	Type[4]:	(Qty) Latches:	Dead Lights:
2	24 x 36	Dual-seal	(2) 260 Ventlok	None
1	36 x 36	Dual-seal	(2) 260 Ventlok	12 x 12 Thermal pane
4	18 x 36	Dual-seal	(2) 260 Ventlok	None

[4] - ***Standard construction (Single-seal type) and Thermal break construction (Dual-seal type)***

Notes:

1) BAH to provide a 2" wide flanged 304 stainless steel discharge collar (5" deep). Mechanically fasten collar to unit with minimum 18-8 SST hardware only.
2)
3) All Interior seams to be caulked with clear FDA approved caulking. The exterior to be caulked with standard caulk. BAH to provide an MSDS sheet for all caulking used.
4) Caulking must be kept to a minimum and not smeared beyond the seam. Caulking shall be rated for temperatures above the maximum design temperature of the unit.
5) All doors to have a safety chain to limit door swing to 90°.
6) BAH to provide a 2" wide flanged stucco aluminum inlet collar (5" deep). Mechanically fasten collar to unit.
7) BAH to provide a C6 x 8.2 lb/ft Steel channel sub-base under the unit channel base.

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WEIGHT

Unit shipped in 3 **sections.** **Max. weight/section:** LB **Max. opening size:** H x W x D *(In.)*

Sec.[5]	Description	Weight LB
1	Inlet/Pre & interm. filter/PHC/PCC	1,700
2	Dehumidifier/Fan	2,900
3	RHC/RCC/Humidifier/Discharge	1,800

Sec.*	Description	Weight LB
4		
5		
6		

[5] - Section (Sec.) listed in direction of airflow.

Total Estimated Weight *(Less Water)* LB: 6,400

FAN

*** Performance data is reflective of one fan ***

Duty	Qty	Mfr.	Model	Size	Dia IN	Rot./Dis.	Cl.	Arr.	ACFM	TSP IN WG	ESP IN WG	Fan BHP	RPM	MRPM	OV FPM
Supply	1	Twin City	BC-SW	150	15	CW/BHD	3	3	1,700	10.50	5.00	4.30	3,565	4,253	1,587

X Bolted Door | X Drain w/ plug | X Inlet Screen(s) | | X 50 % Wheel Width | **HP w/ belt losses:** 4.56

X Nylon Fan Lube Lines (Std) | Screen Enclos. | SPB Bearings | X L10-200K Hrs Bearing Life

Monorail - Fan & Motor | Removable Panel | Large Enough to Remove: Fan & Motor

*** See attached curve(s) for additional performance data ***

Notes:
1) Provide permanently attached directional rotation arrow, painted to contrast with background.
2) BAH to provide an aluminum fan wheel.

MOTOR

Duty	Qty	Mfr.	Type	Efficiency	HP	Nom. RPM	Volt./Ph/Hz	Frame	Wgt. LB	Pos.
Supply	1	Weg	TEFC	Premium	5	3600	460/3/60	184T	89	W

X Extended vinyl motor lube line, if applicable | X Suitable for use w/ VFD

Notes:
1) Motor ground wire to be attached to a ground bar option in its disconnect switch.
2) AHU nameplate to indicate voltage and full load amps.

V-BELT DRIVE

						Motor			Fan			SF = 1.3 x MHP	
Duty	Mfr.	Type	No.	Belts	Ctrs. IN	Shv. OD	Bore IN	Keyway	Shv. OD	Bore IN	Keyway	RPM Range	MRPM
Supply	T.B. Woods	F	1	5M160009	24.61	4.66	1.125	5/16 X 5/32	4.41	1.688	3/8 X 3/16	3,706	3,748

*(**F** = Fixed drive, **A** = Adjustable drive)* *Drive assembly supplied w/* tool-free belt guard w/ tach holes. *Extra set of V-belts* No

Notes:
1) BAH to provide a stainless steel belt guard.
2) BAH to provide a synchronous drive and belts.

VIBRATION ISOLATION

Duty	Mfr.	Qty	Deflect. IN	Base Type	Seismic Isolation	Series Type	% Eff.	Fan Thrust Restraints
Supply	Amber Booth	4	2	Inertia*	Yes	SWSR	99.9	Required

* - Concrete by BAH.

Notes:

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HUMIDIFIER

Mfr.	Qty	Model	H x W	Tube Centers	Absorption Distance	Cap. LBS/HR	Steam PSIG	Type of Steam	Act. By	Type	Signal
Dri-Steem	1	Ultra-Sorb LV	12 x 22 In.	3	18.0 In.	109.0	15.0	Clean	BAH	Pneu.	TBD

Safing Required Yes

*** Parts (valves, strainers, F&T traps, etc.) shall ship loose in the AHU for field installation by others. Reference Piping section. ***

Notes:
1) BAH is providing the STS generator, humidifier panel, control valve, valve actuator (control range of 3-15 PSI), strainer, trap.
2) All interconnecting and supply piping is furnished and installed by others.
3) Humidifier condensate drain connection to be extended to RH side of unit.
4) STS generator shipped loose. Field installation by others.

DESICCANT DEHUMIDIFIER

Notes:
1) BAH to provide a Munters Cargocaire Dehumidifier Model HCD-2250-SBA.
2) The dehumidifier is provided with the following:
   a) Remotely mounted NEMA 4 control enclosure with indicating package for reactivation heat, reactivation fan, and energy modulation reactivation damper (damper is a Johnson damper with a Honeywell actuator). Control panel includes a step down transformer to provide power to low voltage devices.
   b) Siemens S-7 PLC with the OM 73 dual line screen for reactivation and desiccant wheel control. Modbus compatibility is provided with all control integration provided by others.
   c) 1 inch Armaflex interior insulation thoughout supply air plenum to minimize heat transfer and external condensation.
   d) Interior aluminum cladding.
   e) Reactivation fan, 12-1/2" direct drive, 3 HP motor to allow 1.50" ESP.
   f) Reactivation filters, 30% AAF AmAir HT (HT-500) and 65% AAF Varicel HT.
   g) Reactivation steam coils, quantity 3, designed to operate with 96 PSIG steam (3 supply and 3 condensate connections).
   h) Fused Disconnect Switch with grounding bus bar.
3) 460V power and control connections to the control enclosure by others.
4) BAH to provide and install a Photohelic gauge across the reactivation filters. Refer to the filter section for specifics.

FILTER

	Mfr.	Type	Model	% Eff	Cl.	H	x	W	Size(s) IN	Serv.	Frame Mat'l	Gauge
A	Camfil-Farr	Panel	30/30	30		1	x	1	24x24x 2	Up	Stainless Stl.	0-2" Photohelic
A	Camfil-Farr	Cube	Riga-Flo MV11	65		1	x	1	24x24x 12	Up	Stainless Stl.	
B												
C	AAF	Panel	AmAir HT (HT-500)	30		1	x	1	24x24x 2	Up		0-2" Photohelic
C	AAF	Cube	Varicel HT	65		1	x	1	24x24x 12	Up		

Ship Filters With Unit(s) *BAH shall supply* 0 *set(s) of extra filters*

Notes:
1) BAH to mount the Camfil-Farr 30% & 65% filters in a single stainless steel Camfil-Farr Type 8 filter frame.
2) The supply air 30% filters are to be Camfil-Farr part number 049880005.
3) The supply air 65% filters are to be Camfil-Farr part number 402994001.
4)
5)
6)
7)
8) BAH to provide a Dwyer Photohelic gauge part number 3002-MR LT for each filter bank (2 total).
9) The Photohelic gauges will be mounted in a NEMA 3R common electrical enclosure. Pneumatic tubing from the gauges to the enclosure will be by BAH. Connection voltage to the gauges to be 24VDC.
10)
11) BAH to provide a 3-way brass diverting ball valve (McMaster Carr catalog number 46095K61or equivalent) on each Photohelic high and low pressure port. These valves must be easily accessible.
12)
13)
14) The AAF filters are provided with the Munters Cargocaire unit. BAH to provide and install the Photohelic gauge only.

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COIL

Duty	Qty	Mfr.	Model	Fins / Mat'l.	Tube Size /Mat'l.	Csg. Mat'l.	Depth IN	Hdr/Con Mat'l.	Con/Pull Hand
Pre-Heat	1	Aerofin	BNF-12.0AW-29.0 X 24.0-1-1	0.010" Al	5/8" OD x .035" Cu	304 SS	5.0	CS	LH/LH
Pre-Cool	1	Aerofin	W-11.0Aw-30.0 X 26.0-8-0.5	0.0095" Al	5/8" OD x .035" Cu	304 SS	12.5	CS	LH/LH
RHC-1	1	Aerofin	BNF-10.0AW-20.6 X 26.0-2-1	0.010" Al	5/8" OD x .035" Cu	304 SS	5.0	CS	LH/LH
RHC-2	1	Aerofin	BNF-12.0AW-20.6 X 26.0-1-1	0.010" Al	5/8" OD x .035" Cu	304 SS	5.0	CS	LH/LH
Re-Cool	1	Aerofin	W-9.0AW-16.5 X 26.0-4-0.5	0.0095" Al	5/8" OD x .035" Cu	304 SS	7.5	CS	LH/LH

***** See attached coil selections for performance data *****

CS = Carbon Steel
RB = Red Brass

Coil Racks: No *If 'Yes' for:* *Rack Mat'l.:*

Eliminators: No *Type:*

Troughs/Downspouts: No *If 'Yes' for:* *Mat'l.:*

Notes:

1) Aerofin to provide a loose set of manufacturing labels with model numbers identical to what is shown on the coil performance sheets. BAH shall install these labels on the exterior of the unit on the coil removable panels.
2) All coil connection are to be capped for protection during shipping.
3) All coil connections will be MPT.
4) BAH to provide and mount a single bulb thermometer in the access section between the pre-heat coil and the CC. the thermometer will be a Schneider Electric Model Number TC-4111 (TEI P/N ELC90411A) sensing bulb. BAH to mount the thermostat junction box on the roof of the unit (door side). Adjust setpoint to 40°F. BAH to wire from the thermostat junction box to the common electrical enclosure. Sensor to be mounted through the roof of the unit and the tip is to be located in the center of the airstream. Mounting system for the sensor to be similar to that used for the Vaisala sensor.
5) BAH to provide and install a Pyromation averaging RTD with transmitter on the downstream face of the pre-heat coil. Model # is 2290L3(23)(3)-288-8HN63-T440-385U-S (0-100°C).

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MIXING & DISTRIBUTION

No.	Duty	Type	Mfr.	Model	Qty	W IN	x	H IN	Mat'l	Blade	Fail Pos.	Act. By	Type	Signal
1	Outside Air	Damper	Ruskin	CD50	1	18	x	12	AL	Parallel	Closed	BAH	Pneu.	N/A
2	Des. Face	Damper	Ruskin	CD50	1	30	x	24	AL	Opposed	Closed	BAH	Elec.	4 to 20 mA
3	Des. ByPass	Damper	Ruskin	CD50	1	36	x	13	AL	Opposed	Open	BAH	Elec.	4 to 20 mA
4	Balancing	Damper	Ruskin	CD50	1	36	x	13	AL	Opposed	N/A	N/A	N/A	N/A
5	HC Face	Damper	Ruskin	CD50	2	36	x	22	AL	Opposed	Closed	BAH	Elec.	4 to 20 mA
6	RCC Bypass	Damper	Ruskin	CD50	1	36	x	18	AL	Opposed	Open	BAH	Elec.	4 to 20 mA
	Distribution	Diffuser	BAH	Full-Width x Full-Height										

Damper No. that have modulating operators: 2,3,5 & 6 *or have two-position operators:* 1

Notes:

1) Outside air damper (low leakage type):
   a) Blade seal and bearings shall withstand temperatures from -30°F to 150°F.
   b) Supplied with stainless steel bearing sleeves, shaft, and linkage.
   c) BAH to provide with an open & closed limit switch on the damper -(2) Allen Bradley catalog number 440P-MALS11E.
   d) BAH to provide a TAC (formally Siebe) pneumatic actuator catalog no. MK-3121, spring fail closed.
   e) With actuator, provide solenoid valve (ASCO catalog number 8320G184, 24VDC).
   f) BAH to provide a brass needle valve on exhaust port of the solenoid valve & adjust so damper closes in 45 seconds.
   g) BAH to provide a muffler on the exhaust side of the O/A damper solenoid valve. If installed inside the control enclosure, the exhaust air must be ported to the outside of the enclosure.
   h) BAH to provide a 1/4" tube fitting for customer use on the exterior of the unit. The fitting will be used to provide supply air to the damper. BAH to extend pneumatic tubing from the fitting to the supply side of the damper actuator.
   i) Actuator is to mount on the interior of the unit.
2) Face-and-bypass dampers (Dehumidifier and Final Heating Coil/Re-Cooling Coil):
   a) Blade seal shall withstand temperatures from -30°F to 250°F.
   b) Supplied with stainless steel shafts and bearing sleeves suitable for high temperature conditions.
   c) Spring return actuator shall be Johnson Controls No. M9220-HGA-3 (24VDC), wired to common elec enclosure. Provide a 500 ohm resistor for 4-20 mA control of the actuator. Mount resistor in common elec enclosure.
   d) Actuator direct coupled to damper shaft. Face and bypass dampers are linked together. Tie rod shall be minimum 1/2" diameter and/or weld steel angle to reinforce rod to ensure rigidity during high torque conditions.
   e) Actuator is to mount on the interior of the unit.
   f) BAH to cycle the F&BP damper and adjust the span to where the “4 mA” position is the same as the fail closed position (bypass is open), the “12 mA” position to be 50% open, and the “20 mA” position is the face damper fully open and the bypass is closed.
3) All damper jackshafts to be larger than standard (3/4" minimum).
4) The balancing damper is provided with a manually operated locking hand quadrant.
5) The final heating coil face & bypass damper will be linked to the downstream final heating coil face damper. The damper jackshafts to extend through the casing wall on the RH side of the unit. The interconnecting linkage will be located on the exterior of the RH side of the unit. BAH to seal all penetrations through the unit casing. The actuator model and quantity of actuators may change or increase depending on what is required for proper operation. BAH to determine and advise.

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ELECTRICAL

120V Single Point Wiring*:** Yes , ***Motor Single Point Wiring*:** Yes @ 460V ***SPW NEMA Enclosure(s): 3R

Conduit Material: Rigid aluminum ***ETL Label:*** No

Switches	Qty	NEMA	Voltage	HP	Supplied By	Mounted By	Component Served
Mtr. Non-Fused Disconnect(s)	1	3R	460V	5	BAH	BAH	Supply Fan
Mtr. Fused Disconnect(s)	1	3R	460V	3	Munters	Munters	Dehumidifier

Notes:

1) BAH to mount the motor disconnect switch near the fan access door.
2) BAH to wire the motor ground wire to a ground bar option in the disconnect switch.(on supply fan and reactivation fan motor disconnect switches).
3) Provide orange or red '460 Volt' label on the motor disconnect cover.
4) All wiring from various unit mounted electrical components are wired to one (1) 'finger safe' terminal bank located in one (1) NEMA 3R unit mounted junction box. The junction box shall contain the following:
   a) One side of terminal bank shall be reserved for field wiring.
   b) Label the terminal bank as 'TB 3'.
   c) All signal wires (4-20 mA) are run separate from power wires.
   d) All electrical component ground wires shall be attached to one common bus bar located inside the junction box.
5) BAH to use wire ferrules on all termination points.
6) Use aluminum flex conduit for connection to rotating equipment.
7) High voltage and 120V wiring shall be run separate from low voltage (<60 VAC or DC) wires or cable.
8) All wire ends at termination and splits must be numbered according to electrical diagram.
9) All conduit to run as close to the top of the unit as possible and be secured to the AHU wall or roof. No conduit is allowed on or near the floor of the unit. Conduit not to run across any plug panels or access openings. Conduit to be routed in a manner that the coil removable panels will not be hindered or that the conduit comes in contact with the coil connections.
10) Use twisted shielded pair for all signal wires. Sheathing is plenum grade (FA).
11) All control components and control loops must be tested at the main terminal bank. Do not test at the individual device. Attach all internal checkouts pertaining to control tests. Passing initial must be clearly shown. Provide copy of test reports in O&Ms.
12) The 120V power wiring shall use the following color scheme:
   a) Phase A - black
   b) Phase B - red
   c) Phase C - blue
   d) Neutral - white
   e) Ground - green
13) The 460V power wiring shall use the following color scheme:
   a) Phase A - brown
   b) Phase B - orange
   c) Phase C - yellow
   d) Neutral - gray
   e) Ground - green
14) BAH to provide auxiliary contacts in the motor non-fused disconnect switch for use with the customer supplied VFD (VFD's provided and installed in the field by someone other than BAH).
15) All wiring is to be 600V rated type THHN in dry locations and type THWN in wet locations.
16) All wiring to be minimum 12 GA.

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TESTING & SERVICES

BAH shall provide the following factory test(s) in presence of customer(s) with two (2) weeks notice:

[ ] *None* [ ] *Performance (ES-8104)* [ ] *Velocity Profile (ES-8108)*

[X] *Vibration (ES-8107) in accordance with ANSI S2.19, Grade G6.3, w/* 0.16 *IPS filtered in maximum vibration allowed.*

[ ] *Leakage** *(ES-8110, Neg./Pos. Pressure - Orifice Plate)* *Max.* [ ] *% of design CFM @* [ ] *times the operating pressure.*

** - Minimum allowable leakage shall be 50 CFM.* [ ] *Total CFM Allowed at negative* [ ] *" WG & positive* [ ] *" WG*

BAH shall provide the following field service(s) :

[X] *None* [ ] *Start-up* [ ] *Start-up Supervision*

Notes: 1) BAH to complete an Inspection/Testing checkoff sheet provided by Thomas Engineering, Inc. Should any deficiences be found, they are to be recorded on the Inspection Report form.

MISCELLANEOUS NOTES

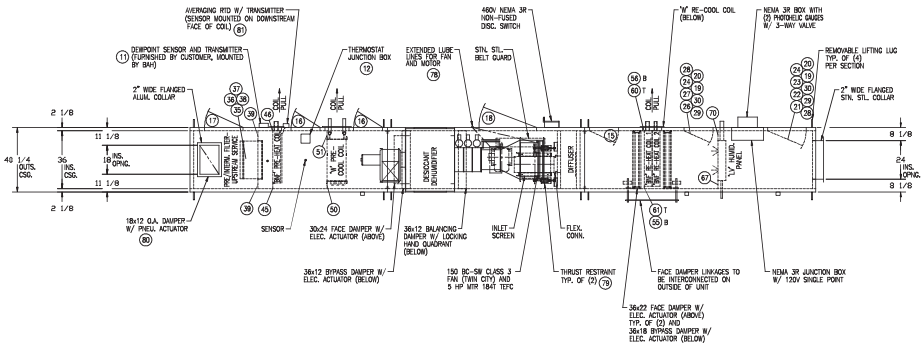
1.	BAH to mount customer supplied Dew Point Sensor and Transmitter (Vaisala Model HMT 335, TEI P/N ELC90631A, 24VDC) in the roof of the unit between pre/intermediate filters and the pre-heat coil. The transmitter is to be mounted on the LH side of the unit near the Dew Point Sensor. BAH to wire from the transmitter to the common electrical enclosure. (For use with the cooling coil). The Dew Point Sensor and Transmitter will remain installed for shipment. BAH to keep the original package and ship with the unit.
2.	All internal air lines shall be metal and not run across any plug panel openings. All lines at termination and splits must be labeled or numbered for ease in assembly or troubleshooting. All lines are to be secured to the AHU wall. It is acceptable for tubing to be run on the side of the unit opposite the doors. Tubing located here should be mounted as close to the unit as possible.
3.	Provide laminated labels as previously provided on S/O #120030 (TCS41152A) and secure with TEK screws. Labels to be white w/ 3/8" black lettering (capitalized). Labels to have 9/32" hole located near each end for mounting and be no wider than 6". Labels are as follows in **BOLD**: a) OA damper - **INLET DAMPER AIR SUPPLY**. Secure label to air supply bulkhead for pneumatic actuator. Add to label description the 25# **operating air supply pressure required**. b) OA damper limit switches - **ZSO 100** (damper open switch) …… **ZSC 100** (damper closed switch) c) OA damper actuator - **FZ 100** d) OA damper solenoid valve - **YV 100** e) OA damper needle valve - **FCV 100** f) Pre/Intermediate filter gauge - **PRE & MEDIUM FILTER** g) Pre and Medium filter gauge - **PDIS 200** h) Photohelic gauges ports - **PRE/MEDIUM TEST PORT HIGH, PRE/MEDIUM TEST PORT LOW, REACTIVATION PRE/MEDIUM TEST PORT HIGH, and REACTIVATION PRE/MEDIUM TEST PORT LOW.** i) Diverting ball valves - Label handle **RUN** and **TEST** j) Heating coils - **STEAM SUPPLY and CONDENSATE RETURN** k) Pre-heat coil RTD transmitter - **TT 110** m) Final heating coil F&BP actuator - **TCZ 150 / TY 150** (if the actuators have a master/slave relationship, label master as **TCZ 150A / TY 150A** and label the slave as **TCZ 150B / TY 150B** n) Dehumidifier F&BP actuator - **MCZ 131 / MY 131** (if the actuators have a master/slave relationship, label master as **MCZ 131A / MY 131A** and label the slave as **MCZ 131B / MY 131B** p) q) r) Reactivation Pre and Medium filter gauge - **PDIS 220** s) Cooling coils connection tagged: **WATER SUPPLY** and **WATER RETURN** t) Cooling (Dehumidification) Vaisala Dew Point Sensor with Transmitter tagged: **MT 131** u) Schneider Electric Freeze Protection Thermostat to be labeled: **TS 001** v) Terminal Bank: **TB 3** w) AHU Auxiliary Contact: **ES 100.**

4.		Do not ship loose items in a coil section. Customer does not want to risk damaging any coil fins during shipment.
5.		BAH to make sure the unit nameplate contains the following information: a) TEI Document Number: TCS41704A b) TEI Air Handling System Serial No: AHU 00407 c) Buffalo Air Handling Serial No: 130079-01
6.		BAH to complete an Inspection/Testing checkoff sheet provided by Thomas Engineering, Inc. The checkoff sheet is a one page document. Should any deficiences be found, they are to be recorded on a separate form.
7.		All exposed openings on the air handler are to be sealed shut.
8.		
9.		Unit to be shipped on a wooden skid. Must use heat treated lumber. Fork lift must be able to pull the skid off of a truck. Skid must extend beyond the largest item protruding off of the AHU.

REVISIONS

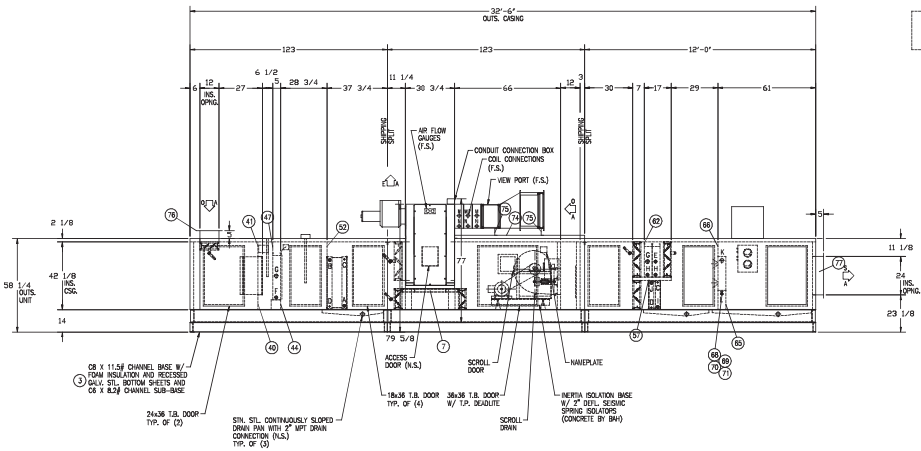
Rev.	Date of Change	Init.	Description of Change(s)
A.	6/25/2013	I.J.	1. FILTER NOTE 4 - "GEL" WAS "GASKET". 2. FILTER NOTE 7 - "A-4S" WAS "B-1S". 3. MIXING NOTE 2C - "HGA" WAS "GGA". 4. HUMIDIFIER NOTE 1 - ADDED CONTROL RANGE. CHG'S PER C.O. #12895
B.	8/26/2013	I.J.	1. UNIT CONSTRUCTION NOTE 7 - ADDED. 2. V-BELT DRIVE NOTE 2 - ADDED. 3. FAN NOTE 2 - ADDED. 4. VIBRATION ISOLATION BASE TYPE WAS STRUCTURAL. 5. DELETED HEPA FILTER BANK "B" AND FRAMES. 6. FILTER NOTES 4-7,10,13 - DELETED. 7. FILTER NOTE 9 - CONNECTION VOLTAGE WAS 120VAC. 8. UNIT CONSTRUCTION NOTE 1 - DELETED "CONTINUOUSLY WELD .....". 9. UNIT CONSTRUCTION NOTE 2 - DELETED. 10. ADDED DAMPER OPERATOR TYPES (TWO POSITION OR MODULATING). 11. MISC. NOTE 3G - WAS SUPPLY AIR PRE/INTERMEDIATE FILTER GAUGE - PDIS 200. 12. MISC. NOTE 3R - WAS SUPPLY AIR PRE/INTERMEDIATE FILTER GAUGE - PDIS 220. 13. DRAIN PAN CONNECTION HAND WAS LEFT HAND. 14. HUMIDIFIER NOTE 3 - ADDED. CHG'S PER C.O. #12965 15. DESICCANT DEHUMIDIFIER NOTE 2A - "REMOTELY MOUNTED" WAS "FACTORY WIRED". 16. FILTER NOTE 12 - DELETED. 17. FILTER NOTE 8 - QTY WAS (3). 18. MISC. NOTE 3H - DELETED "HEPA TEST PORT HIGH" AND "HEPA TEST PORT LOW". 19. MISC. NOTE 3P - DELETED. 20. MISC. NOTE 3Q - DELETED. 21. MISC. NOTE 8 - DELETED. 22. DEHUMIDIFIER/FAN SECTION WEIGHT WAS 2,700#. 23. DISCHARGE SECTION WEIGHT WAS 2,100#. CHG'S PER NEW INFO
C.	9/6/2013	M.C.	1. ADDED DRIVE INFO. 2. REVISED FAN PERFORMANCE PER 12983, 12979

E-13331-1



DESICCANT DEHUMIDIFIER CONTROL PANEL TO BE SHIPPED LOOSE FOR REMOTE MOUNTING BY BY OTHERS

STS GENERATOR FURNISHED BY BAH AND MOUNTED BY OTHERS



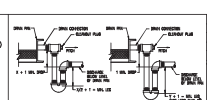
BY	SEQ		TITLE	MOD. NOS., DWG. NOS.	MATERIAL	
	X	1	ASSEMBLY	AS SHOWN	.	
*	1	2	WIRING DIAGRAM	E-13331-2	.	
*	1	3	CHANNEL BASE	E-13331-3	.	
*	1	4	PANELS & DIFFUSER	D-13331-4	.	
*	1	5	INERTIA BASE	C-13331-5	.	
	.	6	.	.	.	
*	1	7	DEHUMIDIFIER STAND	C-13331-7	.	
*	1	8	LABELS	B-13331-8	.	
*	1	9	NAMEPLATE	A-13331-9	STN. STL.	R
	.	10	.	.	.	
*	1	11	SENSOR INSTALLATION	B-12459-11	.	
*	1	12	THERMOSTAT INSTALLATION	B-12459-12	.	
	.	13	.	.	.	
	.	14	.	.	.	
	1	15	DOOR	19-1836T30-TS-O-R	STOCK	
	2	16	DOOR	20-1836T30-TS-O-L	STOCK	Q
	1	17	DOOR	20-2436T30-TS-O-L	STOCK	
	1	18	DOOR	20-3636T30-TS-1210-L	STOCK	
	7	19	SAFETY CHAIN	(1 PER DOOR)	STOCK	
	2	20	HANDLE		STOCK	
	1	21	INS. DOOR PANEL (P4)	1-7/8D X 17-3/16W X 35-1/16L	14GA. 304 STN. STL.	
	1	22	OUTS. DOOR PANEL (P4)	1-7/8D X 17-3/8W X 35-1/4L	.063 STUCCO ALUM.	
	2	23	HORIZ. DOOR FRAME (N7)	1-1/2D x 2-1/4W X 18L	14GA. 304 STN. STL.	
	4	24	VERT. DOOR FRAME	(SEE DXF) 5 X 38-3/4	14GA. 304 STN. STL.	P
	.	25	.	.	.	
	1	26	INS. DOOR PANEL (P4)	1-7/8D X 23-3/16W X 35-1/16L	14GA. 304 STN. STL.	
	1	27	OUTS. DOOR PANEL (P4)	1-7/8D X 23-3/8W X 35-1/4L	.063 STUCCO ALUM.	
	2	28	DOOR HINGE	X 35-1/4L	STN. STL. (STOCK)	
	4	29	DOOR LATCH	DE-STA-CO – #TC-225-U	PURCH.	
	2	30	DOOR GASKETING– ANCHOR	IND. SALES–1/8 X 1–1/2 X 10 YRDS	SILICONE W/PSA (PURCH.)	
	2	31	HORIZ. DOOR FRAME (N7)	1-1/2 X 2-1/4W X 24L	14GA. 304 STN. STL.	
	.	32	.	.	.	
	.	33	.	.	.	N
	2	34	FILTER GAUGE	SEE AC2000	D.O. PURCH.	
~	1	35	FILTER INSTALLATION	A3-3994-3	.	
	1	36	FILTER FRAME	24 X 24	D.O. PURCH./.304 STN. STL.	
	4	37	FILTER CLIP	C-80S	D.O. PURCH.(SHIP W/ UNIT)	
	4	38	FILTER CLIP	C-79-1S	D.O. PURCH.(SHIP W/ UNIT)	
	4	39	VERT. CUTOFF (X9)	2-5/8D X 3-3/4W X 24L	16GA. 304 STN. STL.	
	1	40	HORIZ. CUTOFF (B3)	2-5/8D X 11W X 35-7/8L	16GA. 304 STN. STL.	
	2	41	HORIZ. CUTOFF (X9)	2-5/8D X 6-1/4W X 35-7/8L	16GA. 304 STN. STL.	M
	.	42	.	.	.	
	.	43	PRE-HEAT COIL	.	.	
	1	44	HEATING COIL STAND(HAT)	6-D X 6W X 35-3/4L	14GA. 304 STN. STL.	
	1	45	VERT. CUTOFF (X9)	1-1/2D X 6-7/8W X 35-3/4L	16GA. 304 STN. STL.	
	1	46	VERT. CUTOFF (X9)	1-1/2D X 1-1/2W X 35-3/4L	16GA. 304 STN. STL.	
	1	47	HORIZ. CUT-OFF (X9)	1-1/2D X 8-1/2W X 35-7/8L	16GA. 304 STN. STL.	
	.	48	.	.	.	L
	.	49	COOLING COIL	.	.	
	1	50	VERT. CUTOFF (X9)	2-1/4D X 4-3/4W X 41-3/4L	16GA. 304 STN. STL.	
	1	51	VERT. CUTOFF (X9)	2-1/4D X 5-1/4W X 41-3/4L	16GA. 304 STN. STL.	
	1	52	HORIZ. CUT-OFF (X9)	2-1/4D X 19-1/2W X 35-7/8L	16GA. 304 STN. STL.	
	.	53	.	.	.	
	.	54	RE-COOLING COIL	.	.	
	1	55	VERT. CUTOFF (X9)	4-3/4D X 7-3/4W X 17-3/4L	16GA. 304 STN. STL.	
	1	56	VERT. CUTOFF (X9)	4-3/4D X 5-1/4W X 17-3/4L	16GA. 304 STN. STL.	K
	1	57	HORIZ. CUT-OFF (X9)	4-3/4D X 3/4W X 35-7/8L	16GA. 304 STN. STL.	
	.	58	.	.	.	
	.	59	RE-HEATING COIL	.	.	
	1	60	VERT. CUTOFF (X9)	2D X 1-1/2W X 21-5/8L	16GA. 304 STN. STL.	
	1	61	VERT. CUTOFF (X9)	2D X 3-7/8W X 21-5/8L	16GA. 304 STN. STL.	
	1	62	HORIZ. CUT-OFF (X9)	2D X 3/4W X 35-7/8L	16GA. 304 STN. STL.	
	.	63	.	.	.	
	.	64	HUMIDIFIER	.	.	J
	1	65	STAND (PT–30016)	L1=35-3/4,L2=20,A=5-1/2,B=12,C=1-1/2, D=2-3/4	12GA STN. STL.	
	1	66	HORIZ. CUT-OFF (X9)	2D X 13-1/2W X 35-7/8L	16GA. 304 STN. STL.	
	2	67	VERT CUTOFF (X9)	2D X 7-1/2W X 29-3/4L	16GA. 304 STN. STL.	
	2	68	NIPPLE	3/4" X 2L	SCH. 40 STN. STL.	
	1	69	UNION	3/4" CL. 150	STN. STL.	
	1	70	ELBOW	3/4" CL. 150	STN. STL.	H
	2	71	PIPE	3/4" X LIN. FT.	SCH. 40 STN. STL.	
	.	72	.	.	.	
	.	73	.	.	.	
	2	74	SUPPORT (HAT)	(SHOP TO FAB. AS REQ'D.)	3/16" ALUM.	
	2	75	SUPPORT (B3)	(SHOP TO FAB. AS REQ'D.)	3/16" ALUM.	
	1	76	COLLAR (PT–50013)	D=12,R=18,L=10–1/8 (EXC. 1–1/2=2)	.063 STUCCO ALUM.	
	1	77	COLLAR (PT–50013)	D=24,R=24,L=7–1/8 (EXC. 1–1/2=2)	12GA. 304 STN. STL.	
	1	78	EXTENDED LUBE LINES	ES–3301–7 (FAN & MOTOR)	STOCK	
	1	79	THRUST RESTRAINT	B–2568–1	STOCK	G
	1	80	ACTUATOR (PNEUMATIC)	TAC – MK–7121	D.O. PURCH.	
	1	81	SENSOR/TRANSM. INSTALL.	(SEE ES–4252)	STOCK	

COIL CONNECTIONS		
A	SUPPLY	1–1/2" MPT
B	RETURN	1–1/2" MPT
C	VENT	3/8" MPT
D	DRAIN	3/8" MPT
E	SUPPLY	1–1/2" MPT
F	RETURN	1–1/2" MPT
G	SUPPLY	2" MPT
H	RETURN	1–1/2" MPT
I	SUPPLY	1–1/2" MPT
J	RETURN	1–1/2" MPT
K	SUPPLY	2" MPT
L	DRAIN	3/4" MPT
M	SUPPLY	1–1/2" MPT
N	RETURN	1–1/4" MPT

NOTES:
1. UNIT TO HAVE THERMAL BREAK CONSTRUCTION.
2.
3. ALL DOORS TO HAVE A SAFETY CHAIN TO LIMIT DOOR SWING TO 90°.

UNIT MUST BE INSTALLED AND OPERATED IN ACCORDANCE WITH MANUAL GB75G.

GENERAL NOTES:
- UNIT MUST BE INSTALLED AND OPERATED IN ACCORDANCE WITH SERVICE MANUAL GB75G.
- WHEN FAN(S) IS IN OPERATIONAL INLET OR DUCT DAMPER(S) MUST BE OPEN TO PREVENT DAMAGE TO THE UNIT.
- UNIT TO BE INSTALLED ON LEVEL SURFACE.
- CURB/STEEL MOUNTED UNITS 10'-0" WIDE MUST HAVE PERIMETER SUPPORT AND SUPPORT BENEATH EACH DIVIDER PANEL.
- CURB/STEEL MOUNTED UNITS OVER 15'-0" MAY REQUIRE ADDITIONAL SUPPORT. CONSULT FACTORY.
- SECTIONS MAY DEFLECT DURING RIGGING. SUPPLEMENTARY SUPPORT MIGHT BE AT SHIPPING SPLITS WILL FACILITATE PLACEMENT OF SECTIONS.
- TRAP(S) IN DRAIN LINES BY OTHERS. REFER TO TRAP DETAIL (RIGHT)



ENGINEER: THOMAS ENGINEERING, INC. / MARTY BERTHOLD
MARK: TCS4170HA AHU 00407

REV.	DESCRIPTION	BY	DATE
A	ADDED 30% FAN HEIGHTS ADDED 30% FAN DATA CHG'D TO 1/2 IN. FLANGE CHG'D TO 2" FLANGE		
B	REVISED DRAIN PAN ADDED 2" MPT DRAIN ADDED DRAIN PAN NOTE ADDED DETAIL OF DRAIN PAN ADDED DRAIN PAN NOTE ADDED DRAIN PAN NOTE ADDED DRAIN PAN NOTE

E-13331-2

"ON "DWG

RED OR ORANGE LABEL REQUIRED ON DISCONNECT COVER WITH 1" HIGH LETTERING "460 VOLT"

NEMA 3R NON FUSED DISCONNECT

3 PH POWER FROM VFD

PROCESS BLOWER MOTOR

5 HP 3600 RPM 460/3/60

GND

AUX CONTACT ES 100 TO BE WIRED TO VFD STOP CKT (BY OTHERS)

CONDUIT TO BE RIGID ALUMINUM WITH 36" MAX FLEX AT MOTOR
WIRING TO MIN AWG #12 TYPE THHN IN DRY LOCATIONS AND TYPE THWN IN WET LOCATIONS
120V POWER WIRING COLORS AS FOLLOWS
PHASE A - BLACK
PHASE B - RED
PHASE C - BLUE
NEUTRAL - WHITE
GROUND 0 GREEN
460V POWER WIRING COLORS AS FOLLOWS:
PHASE A - BROWN
PHASE B - ORANGE
PHASE C - YELLOW
NEUTRAL - GRAY
GROUND - GREEN
5 HP MOTOR WIRING TO BE MINIMUM AWG #12 IN 3/4" CONDUIT

TYPICAL CONNECTIONS FOR PHOTOHELIC GAUGES

HI PRESSURE BULKHEAD CONN

TO UPSTREAM OF FILTER

LO PRESSURE BULKHEAD CONN

TO DOWNSTREAM OF FILTER

3 WAY VALVE

RUN

TEST

HI

LO

PHOTOHELIC GAUGE

BULKHEAD CONNS ON DOOR FOR GAUGE CALIBRATION

HI PORT TEST

LO PORT TEST

NEMA 4 PANEL
16 X 16 X 6

HI

LO

TB 3

TERMINAL STRIP

30 & 65% FILTER PHOTOHELIC

PDIS 200

A3002-MR-LT

REACTIVATION FILTER PHOTOHELIC

PDIS 220

A3002-MR-LT

H HI PORT TEST

L LO PORT TEST

GROUND BAR

FACTORY TO MOUNT TERMINAL STRIP TO SIDE SO THAT THERE IS NO INTERFERENCE WITH MAGNEHELIC GAUGES

DEHUMIDIFIER CONTROL PANEL (REMOTE MTD)

DEHUMIDIFIER JUNCTION BOX

460/3/60 POWER (BY OTHERS)

SEE MUNTERS DATA FOR DETAILS

WIRING FROM REMOTE MTD CONTROL PANEL TO DEHUMIDIFIER J/B (BY OTHERS)

PDIS 200

HI SET POINT

30% & 65% FILTER PHOTOHELIC

PDIS 220

HI SET POINT

REACTIVATION FILTER PHOTOHELIC

GND

NC

NO

COM

17

18

19

20

RED 14

BLACK 16

DO NOT GROUND SHIELD AT THIS END (TYPICAL)

MT 131

DEW POINT SENSOR/ TRANSMITTER MOUNTED BY BAH

24VDC

CH 1

36 BLACK

35 RED

15 BLUE W/ WHITE TRACER

13 BLUE

37

RE-HEAT COIL FACE & BYPASS DAMPER ACTUATOR FACE FAIL CLOSED BYPASS FAIL OPEN TCZ 150/TY 150

DEHUMIDIFIER FACE & BYPASS DAMPER ACTUATOR FACE FAIL CLOSED BYPASS FAIL OPEN MCZ 131/MY 131

40 VA TRANSFORMER 120/24V

2

5

2A

5A

2 RED 24V+

1 BLK COM

GND

3 GRY 4-20 MA+

4-20 MA-

38

39

40

41

42

43

ZSO 100

LIMIT SWITCH CLOSES WHEN DMPR OPENS

ZSC 100

LIMIT SWITCH CLOSES WHEN DMPR CLOSES

N.O.

21

22

23

24

TS 001 FREEZSTAT

25

26

ENERGIZED AIR TO OPEN, DE-ENERGIZED SPRING RETURN TO CLOSE

SOV YV 100

12

11

PNEUMATIC INLET DAMPER ACTUATOR

AIR IN

EXHAUST PORT

FZ 100

NEEDLE VALVE ADJUSTED FOR 45 SECONDS FOR DAMPER TO CLOSE

FCV 100

TT 110

AVG TYPE RTD SENSOR ON DISC SIDE OF PRE HEAT COIL

29

30

31

TWISTED SHIELDED PAIR (TYPICAL)

39 500 OHM

40 500 OHM

43 500 OHM

TGL1 GROUND KIT

GROUND

TB3

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50

BARRIER

115 VAC — AC COM

F & BP MTR POWER

24VDC — DC COM

INLET DMPR SOLENOID POWER

24VDC — DC COM

DEWPOINT SENSOR & PHOTOHELICS POWER

NO — COM — NO — COM — NO — COM — COM — NC

AHU FILTER PHOTOHELICS

REACT FILTER PHOTOHELIC

INLET DMPR OPEN

INLET DMPR CLOSED

FREEZSTAT

MA + — MA - — SHIELD

PRE HEAT COIL DISC TEMP

MA + — MA - — SHIELD

DEWPOINT SENSOR OUTPUT

MA + — MA - — SHIELD

RE-HEAT COIL F&BP DMPR INPUT

MA + — MA - — SHIELD

DEHUMIDIFIER F&BP DMPR INPUT

COMPONENT LABELS

ITEM NO	QTY	DESCRIPTION	MODEL NUMBER	MANUFACTURER
-01	1	NEMA 3R N-F DISC SW	HU-361RB, 30A, 600V	SQUARE D
1	2	AUX CONTACT KIT	EIK031	SQUARE D
1	3	GROUND KIT	GTK03	SQUARE D
1	4	NEMA 4 ENCLOSURE	C-SD16166	HOFFMAN
1	5	SUB PANEL	C-P1616	HOFFMAN
6	6	PHOTOHELIC GAUGE	3002-MR-LT	DWYER
6	7	BRASS 3 WAY VALVE	46095K61	McMASTER CARR
1	8	TERMINAL BLOCKS	1492-H1	ALLEN BRADLEY
10	9	BARRIER	1492-N36	ALLEN BRADLEY
2	10	END ANCHOR	1492-N23	ALLEN BRADLEY
1	11	MOUNTING RAIL	1492-N1	ALLEN BRADLEY
1	12	JUMPER STRIP	1492-N39	ALLEN BRADLEY
1	13	GROUND BAR KIT	TGL-1	GE
1	14	DA DAMPER ACTUATOR	MK-3121	SIEBE
2	15	DAMPER LIMIT SWITCH	440P-MALS11E	ALLEN BRADLEY
1	16	SOLENOID VALVE	8320G184 - 24VDC	ASCO
1	17	FXF NEEDLE VALVE	AE-203	J.T. DAVIS
1	18	MUFFLER & ADAPTER	4450K1 & 50915K215	McMASTER CARR
2	19	F & BP DAMPER ACTUATOR	M9220-HGA-3	JOHNSON
2	20	500 OHM RESISTOR KIT	985-124	SIEMENS
1	21	DEW PT TRANSMITTER	HMT 335 (BY T.E.I.)	VAISALA
1	22	FREEZSTAT	TC-4111	TAC
1	23	40 VA TRANSFORMER	Y-65A13-0 (120/24V)	JOHNSON
1	24	AVG TYPE RTD W/ XMTTR	2290L3(23)(3)-288-8HN63 -T40-385Ω-S, 0-10VDC	PYROMATION
1	25			

TT 110

TS 001

HT 131

TCZ 150/TY 150 & MCZ 150/MY 150

FCV 100

YV 100

ZSO 100 & ZSC 100

FZ 100

TB-3

PDIS 200 30 & 65% FILTERS
PDIS 220 REACTIVATION FILTER

ES-100

AHU-00407

BILL OF MATERIAL

CUSTOMER	THOMAS ENGINEERING, INC., HOFFMAN ESTATES, IL
USER	BMS
TITLE	WIRING DIAGRAM FOR AHU-00407
NAME	G.E.K.
DATE	08/23/13
SCALE	NONE

DRAWN | DWG. STATUS | CHECKED | APPROVED

THIRD ANGLE PROJECTION

NEXT ASSEMBLY NO.

ID. NO. 1300079-01

JOB NO. 13331

DWG. NO. E-13331-2

REV. A

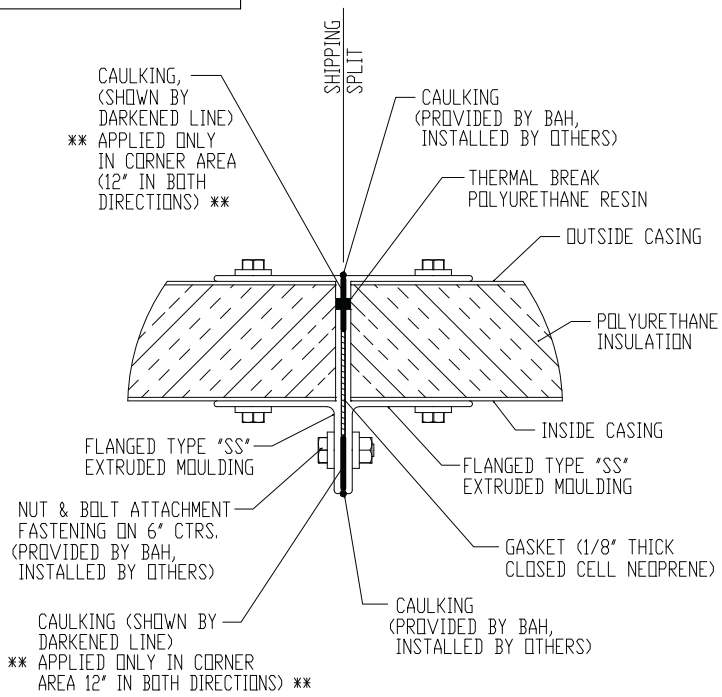
THIS DRAWING IS THE PROPERTY OF BUFFALO AIR HANDLING AND IS RETURNABLE UPON REQUEST. IT IS FOR THE CONFIDENTIAL USE OF THE BUYER OF THIS EQUIPMENT AND MUST NOT BE COPIED, OR SHOWN TO ANY THIRD PARTY, WITHOUT PRIOR WRITTEN AUTHORIZATION OF BUFFALO AIR HANDLING. THE USE OF THIS DRAWING IN WHOLE OR IN PART FOR PROCURING PARTS FROM OTHERS IS PROHIBITED AND VOIDS OUR EQUIPMENT WARRANTY.

BUFFALO AIR HANDLING

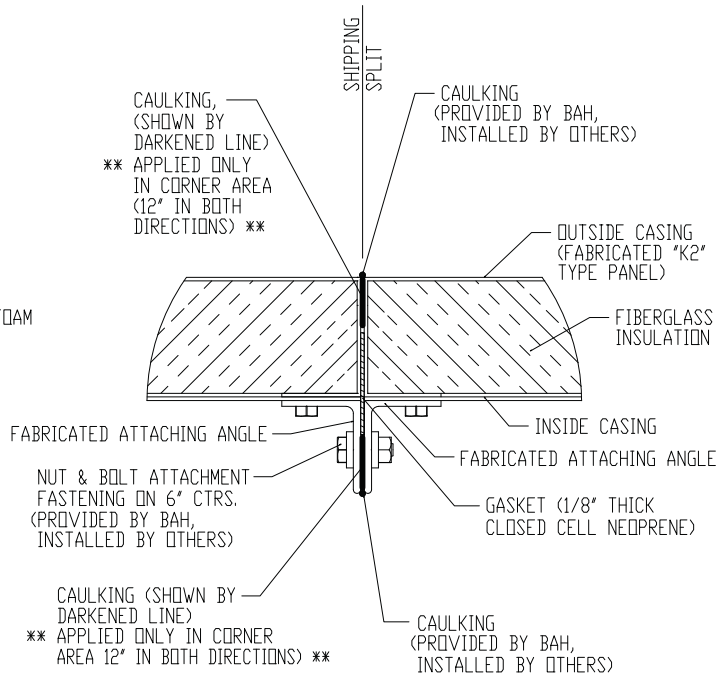
REV. A DELETED PHOTO HELICS USE ON HEPA FILTERS AND REDUCED SIZE OF PANEL 8/30/13 G.E.K.

FIRST USED ON ORDER —

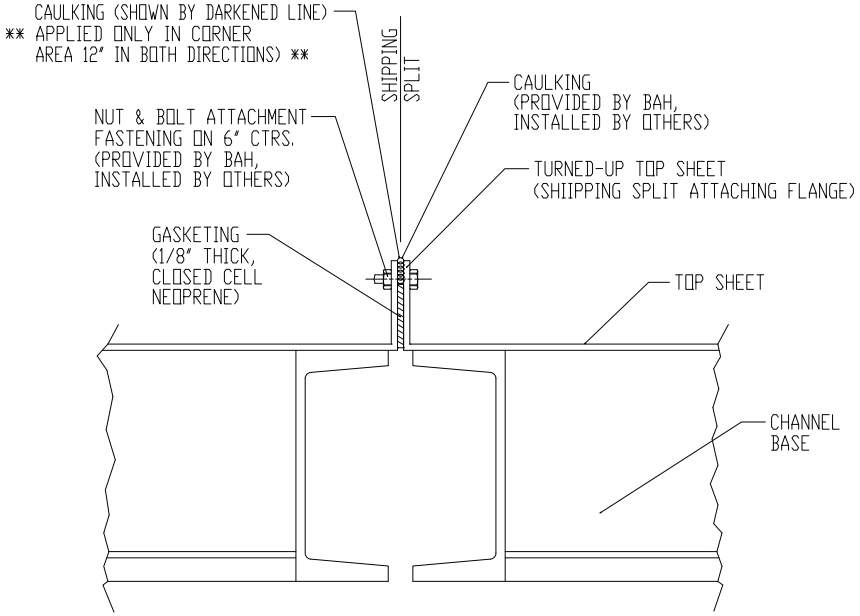
ES-10100


SHIPPING SPLIT
CAULKING, (SHOWN BY DARKENED LINE) ** APPLIED ONLY IN CORNER AREA (12" IN BOTH DIRECTIONS) **
CAULKING (PROVIDED BY BAH, INSTALLED BY OTHERS)
THERMAL BREAK POLYURETHANE RESIN
OUTSIDE CASING
POLYURETHANE FOAM INSULATION
INSIDE CASING
FLANGED TYPE "SS" EXTRUDED MOULDING
FLANGED TYPE "SS" EXTRUDED MOULDING
NUT & BOLT ATTACHMENT FASTENING ON 6" CTRS. (PROVIDED BY BAH, INSTALLED BY OTHERS)
GASKET (1/8" THICK CLOSED CELL NEOPRENE)
CAULKING (SHOWN BY DARKENED LINE) ** APPLIED ONLY IN CORNER AREA 12" IN BOTH DIRECTIONS) **
CAULKING (PROVIDED BY BAH, INSTALLED BY OTHERS)

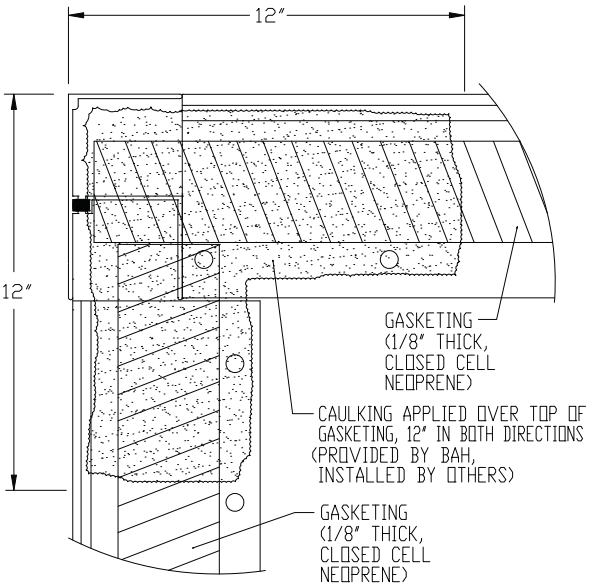
POLYURETHANE FOAM PANEL
WALL & ROOF SHIPPING SPLIT


SHIPPING SPLIT
CAULKING, (SHOWN BY DARKENED LINE) ** APPLIED ONLY IN CORNER AREA (12" IN BOTH DIRECTIONS) **
CAULKING (PROVIDED BY BAH, INSTALLED BY OTHERS)
OUTSIDE CASING (FABRICATED "K2" TYPE PANEL)
FIBERGLASS INSULATION
INSIDE CASING
FABRICATED ATTACHING ANGLE
FABRICATED ATTACHING ANGLE
NUT & BOLT ATTACHMENT FASTENING ON 6" CTRS. (PROVIDED BY BAH, INSTALLED BY OTHERS)
GASKET (1/8" THICK CLOSED CELL NEOPRENE)
CAULKING (SHOWN BY DARKENED LINE) ** APPLIED ONLY IN CORNER AREA 12" IN BOTH DIRECTIONS) **
CAULKING (PROVIDED BY BAH, INSTALLED BY OTHERS)

FIBERGLASS "K2" PANEL
WALL & ROOF SHIPPING SPLIT


CAULKING (SHOWN BY DARKENED LINE) ** APPLIED ONLY IN CORNER AREA 12" IN BOTH DIRECTIONS) **
SHIPPING SPLIT
CAULKING (PROVIDED BY BAH, INSTALLED BY OTHERS)
NUT & BOLT ATTACHMENT FASTENING ON 6" CTRS. (PROVIDED BY BAH, INSTALLED BY OTHERS)
TURNED-UP TOP SHEET (SHIPPING SPLIT ATTACHING FLANGE)
GASKETING (1/8" THICK, CLOSED CELL NEOPRENE)
TOP SHEET
CHANNEL BASE

CHANNEL BASE SHIPPING SPLIT


12"
12"
GASKETING (1/8" THICK, CLOSED CELL NEOPRENE)
CAULKING APPLIED OVER TOP OF GASKETING, 12" IN BOTH DIRECTIONS (PROVIDED BY BAH, INSTALLED BY OTHERS)
GASKETING (1/8" THICK, CLOSED CELL NEOPRENE)

WALL/ROOF CORNER AT SHIPPING SPLIT

This drawing is the property of Buffalo Air Handling and is returnable upon request. It is for the confidential use of the buyer of the equipment and must not be reproduced, or shown to any third party, without prior written authorization of Buffalo Air Handling.

REFERENCE: ES-1306

TITLE: Shipping Split Attachment & Sealing Standard For Indoor Unit		
DRAWING STATUS: Complete	DESIGNER: EKA	APPROVED BY: TRK
BUFFALO AIR HANDLING	DATE: 5/13/10	PAGE: 1 of 1
	DRAWING NO. (REF. JO#): ES-10100	REV.

2
Fans

Twin City Fan & Blower

A Twin City Fan Company

5959 Trenton Lane · Minneapolis, MN 55442-3238
Phone (763) 551-7600 · Fax (763) 551-7601 · www.tcf.com

ISO 9001 CERTIFIED

Customer: Buffalo Air Handling
Job Name: Thomas Engineering BMS Mount Vernon, IN
Job ID: 130079

August 30, 2013

Fan Description

Tag	TCS41704A / AHU 00407 rev
Quantity	1
Type	BC-SW
Size	150
Width	SWSI
Arrangement	3
Class	III
Rotation	CW
Discharge	BHD
Wheel diameter (in.)	15
Drive method	60 Hz belt drive
Percentage width	50%
Percentage diameter	100%

Fan Performance

CFM	1,700
Operating SP (in.wg)	10.5
Standard SP (in.wg)	10.65
RPM	3565
Tip Speed (fpm)	14,000
Oper. BHP	4.30
Standard BHP	4.36
Outlet area (sq. ft)	1.071
Outlet Velocity (fpm)	1,587
Temperature (°F)	70
Altitude (ft)	387
Density (lb/ft³)	0.074
Max RPM for Class	4253
Static Efficiency	65.26
Total Efficiency	66.22

Motor Data

HP	5
RPM	3600
Voltage	460V
Phase	3
Hz	60
Enclosure	TEFC
Efficiency	Prm.Eff.
Frame	184T
Motor position	

Modifiers

% width: 50%

Sound

Sound Power Levels in dB re. 10^{-12} Watts:

Octave Bands	1	2	3	4	5	6	7	8	LwA
Level at Inlet	100	96	88	93	93	88	86	85	97

Estimated sound pressure level in dBA (re: 0.0002 microbar) based on a single* ducted installation:

Distance in ft	1	3	5
dBA at Inlet	97	87	83

*To estimate dBA level for ducted inlet and ducted outlet (into and out of the room) type installation, deduct 20 from the LwA value shown.

Using a directivity factor of 1.

Estimated Sound Pressure based on free field, spherical (Q = 1) radiation at the stated distance.

Definitions:

LwA — The overall (single value) fan sound power level, 'A' weighted.

dBA — The environment for each fan installation influences its measured sound value, therefore dBA levels cannot be guaranteed. Consult AMCA Publication 303 for further details. A fan's dBA is influenced by nearby reflective surfaces.

All quotations per Twin City Fan Terms and Conditions found at http://www.twincityfan.com/TC_TCF.pdf

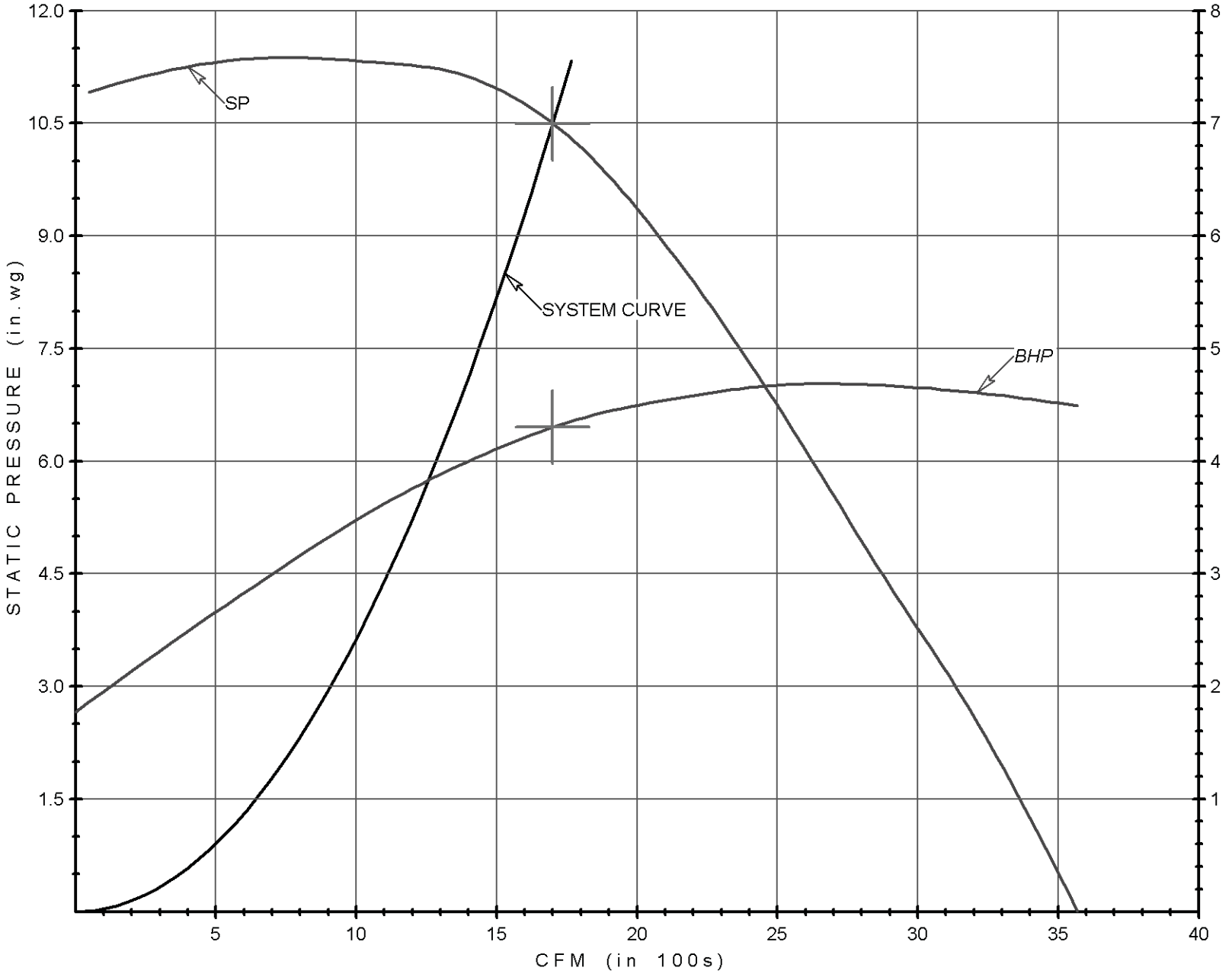
97

Customer: Buffalo Air Handling	Fan Tag: TCS41704A / AHU 00407 rev
Job ID: 130079	Model: 150 BC-SW
Represented By: Buffalo Air Handling 434-946-7455	

CFM:	1,700
SP:	10.5 in.wg
RPM:	3565
BHP:	4.30
Outlet Velocity:	1,587
Density:	0.074

Corrected for:
% width: 50%
Altitude 387

TWIN CITY FAN AND BLOWER PERFORMANCE CURVE



Inlet Sound Power

Octave	Level
1	100
2	96
3	88
4	93
5	93
6	88
7	86
8	85

in db re 10^{-12} watts

08/30/2013

3
Motors

No.:

Date: 1/13/2012

DATA SHEET
Three-phase induction motor - Squirrel cage rotor

Customer	:
Product line	: W22 NEMA Premium - Ball Bearings

Frame	: 184T
Output	: 5 HP
Frequency	: 60 Hz
Poles	: 2
Full load speed	: 3500
Slip	: 2.78 %
Voltage	: 208-230/460 V
Rated current	: 13.1-11.8/5.90 A
Locked rotor current	: 88.5/44.3 A
Locked rotor current (Il/In)	: 7.5
No-load current	: 4.40/2.20 A
Full load torque	: 7.40 lb.ft
Locked rotor torque	: 270 %
Breakdown torque	: 390 %
Design	: B
Insulation class	: F
Temperature rise	: 80 K
Locked rotor time	: 25 s (hot)
Service factor	: 1.25
Duty cycle	: S1
Ambient temperature	: -20°C - +40°C
Altitude	: 1000 m
Degree of Protection	: IP55
Approximate weight	: 88 lb
Moment of inertia	: 0.22330 sq.ft.lb
Noise level	: 69 dB(A)

	D.E.	N.D.E.
Bearings	6207 ZZ	6206 ZZ
Regreasing interval	---	---
Grease amount	---	---

Load	Power factor	Efficiency (%)
100%	0.89	88.5
75%	0.85	88.5
50%	0.76	86.5

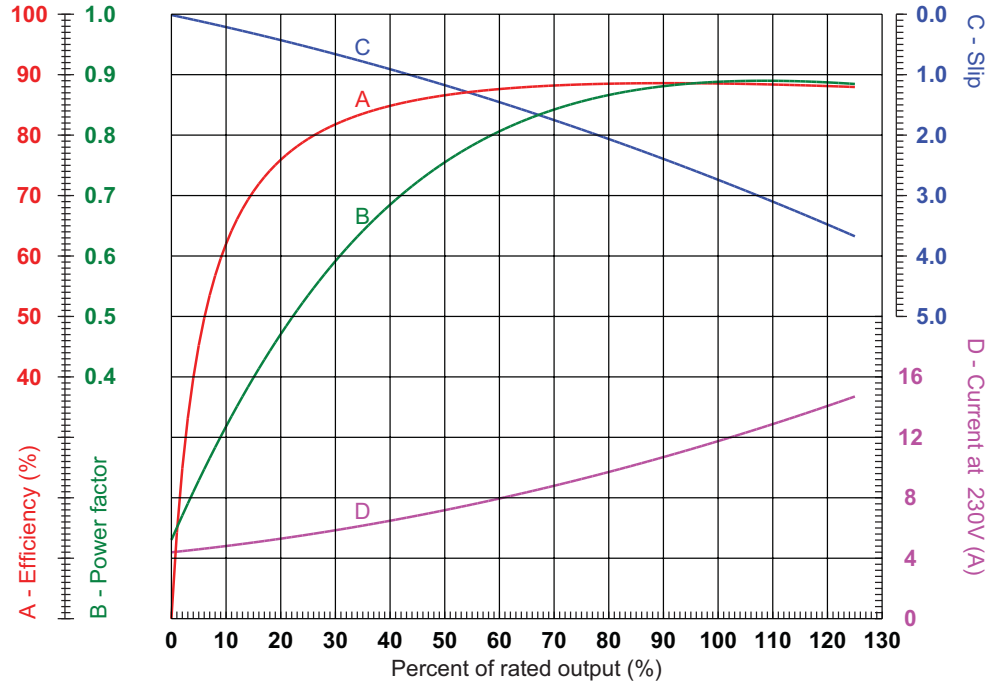
Notes:

Performed by:	Checked:

	No.:
	Date: 1/13/2012

PERFORMANCE CURVES RELATED TO RATED OUTPUT

Three-phase induction motor - Squirrel cage rotor



Customer	:		
Product line	:	W22 NEMA Premium - Ball Bearings	
Output	: 5 HP	Locked rotor current (Il/In)	: 7.5
Frame	: 184T	Duty cycle	: S1
Full load speed	: 3500	Service factor	: 1.25
Frequency	: 60 Hz	Design	: B
Voltage	: 208-230/460 V	Locked rotor torque	: 270 %
Insulation class	: F	Breakdown torque	: 390 %
Rated current	: 13.1-11.8/5.90 A		

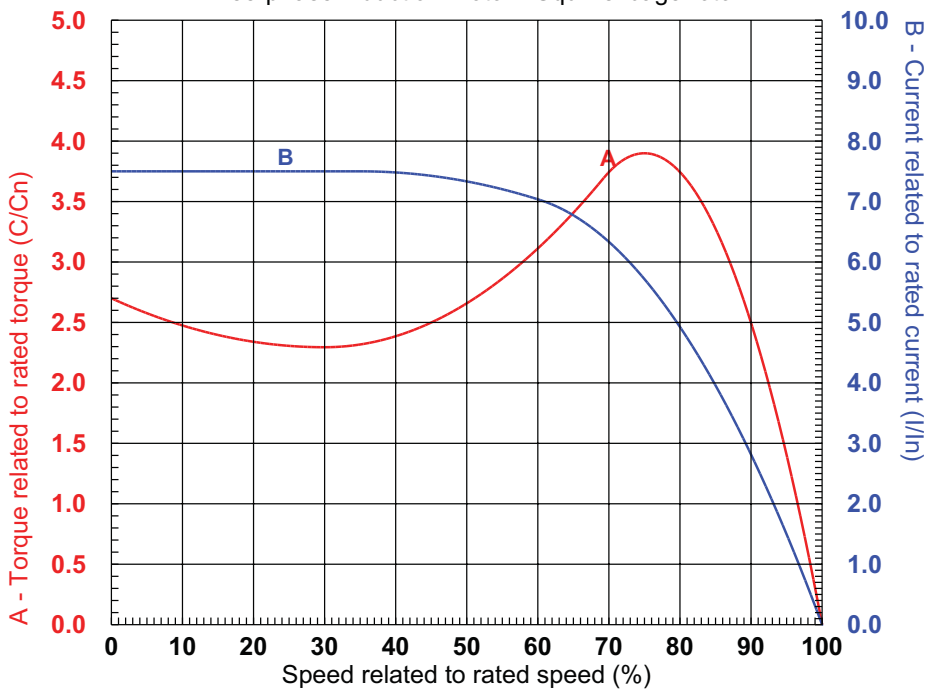
Notes:

Performed by:	Checked:

	No.:
	Date: 1/13/2012

CHARACTERISTIC CURVES RELATED TO SPEED

Three-phase induction motor - Squirrel cage rotor

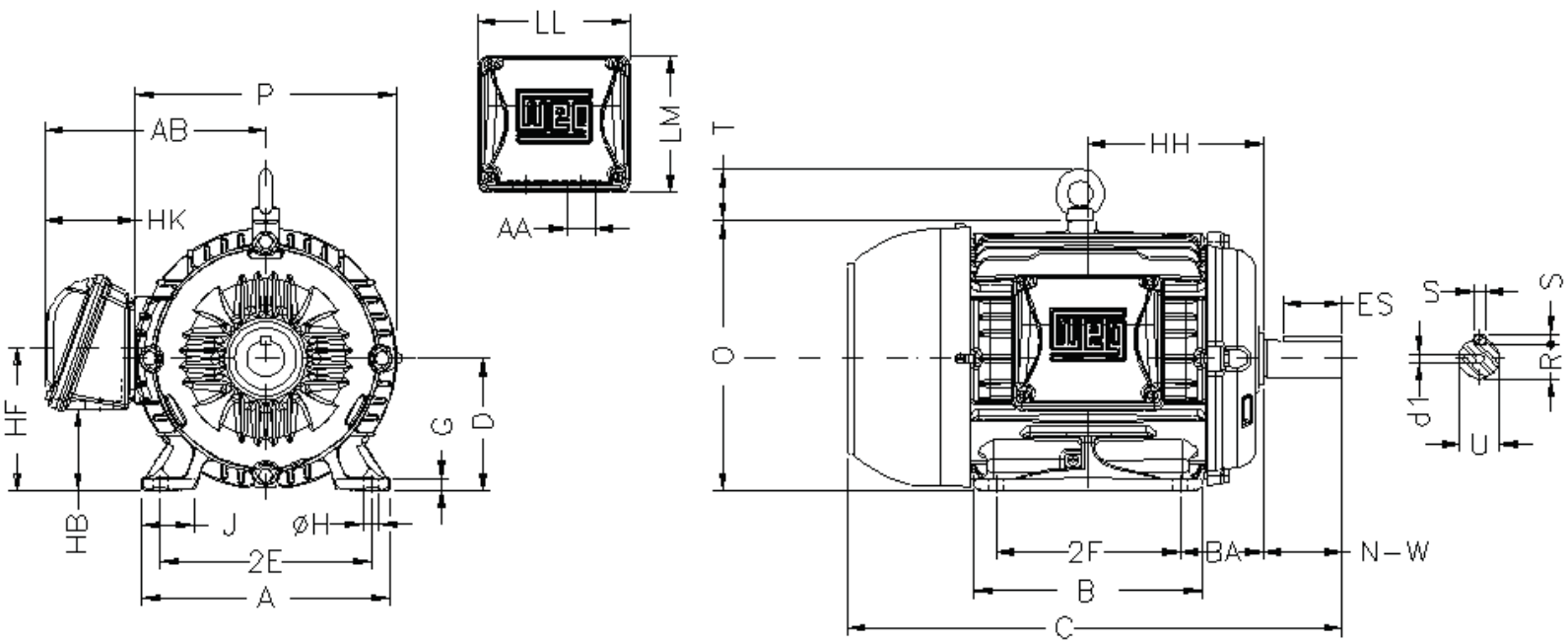


Customer	:
Product line	: W22 NEMA Premium - Ball Bearings

Output	: 5 HP	Locked rotor current (Il/In)	: 7.5
Frame	: 184T	Duty cycle	: S1
Full load speed	: 3500	Service factor	: 1.25
Frequency	: 60 Hz	Design	: B
Voltage	: 208-230/460 V	Locked rotor torque	: 270 %
Insulation class	: F	Breakdown torque	: 390 %
Rated current	: 13.1-11.8/5.90 A		

Notes:

Performed by:	Checked:



					Notes:
2E 7.500	J 1.594	A 8.661	P 8.740	AB 7.559	Performed by:
2F 5.500	B 6.969	BA 2.750	U 1.125	N-W 2.750	Checked:
ES 1.969	S 0.250	R 0.984	depth 0.250	D 4.500	Customer:
G 0.394	HB 2.236	O 9.343	T 1.772	HF 4.500	W22 NEMA Premium - Ball Bearings
HH 5.500	HK 3.110	H 0.406	C 15.860	LL 5.512	
LM 5.236	AA NPT 1"	d1 A 4	d2 A 4	Flange FD-254	Three-phase induction motor Frame 184T - IP55
AJ 10.000	AK 9.000	BD 11.00	BF 0.562	BB 0.203	1/13/2012

4
Coils

AEROFIN
Heat Transfer Products

Date: 08/06/2013
Job Name: Thomas - Mt. Vernon, IN
System ID: Pre-HC-0FLEX rev B
Quote No. 130079-01

Model No.	Qty. In Face	NTL INCH	Total Weight LBS.
BNF-12.0AW-29.0 X 24.0-1-1	1	24.00	60
Totals:	1		60

Coil Type: BNF
TF: 14
Row: 1
Fin: 12.00 / IN
Circuit: N/A

Tube: 0.625 inch X 0.035 inch Copper Seamless Tubes
Fin Material: Series 71B Aluminum
Csg Material: Standard with Stainless Stl Casings
Connection: See Drawing Carbon Stl, Extended 5 inches,
Hdr Material: Standard Carbon Stl with Silver Brazed Joints

Thickness: 0.01 IN.

Dwg: CA-140-3BNF-229

Performance NV

Pressure: 29.50 IN HG Elevation: 387.0 FT

Airflow:	1,700.0	SCFM
System Face Area:	4.4	FT^2
Standard Face Velocity:	386.3	FPM
Entering Dry Bulb Temp:	-4.0	°F
Leaving Dry Bulb Temp:	50.0	°F
Outside Surface Fouling:	0.0000	$HR{\cdot}FT^2{\cdot}°F/BTU$
Sensible Heat Load:	99.0	MBH
Total Heat Load:	99.0	MBH

Saturated Steam

Steam Press:	12.0	PSIG
Steam Temp:	243.0	°F
Condensate Rate:	104.2	LB/HR
Inside Surface Fouling:	0.0000	$HR{\cdot}FT^2{\cdot}°F/BTU$

Losses
Air Friction: 0.03 IN H2O

Comments:

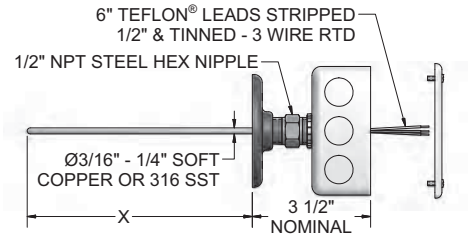
Notes & Warnings:

51 Outside the scope of AHRI standard 410.

Special-Purpose

Configuration Code SP06
RTD Averaging Sensor

The averaging RTD sensor listed below measures the temperature over the entire sheath length to provide an average temperature measurement of the cross sectional area of air ducts, room gradient temperatures, and other low temperature averaging applications. The sensing element has a resistance output that conforms to a 100 Ω platinum element with a 0.003 85 $^{\circ}C^{-1}$ temperature coefficient within a measurement range of (0 to 100) ºC [32 to 212] ºF. The RTD sensors are available in copper or 316 stainless steel sheath materials and can be supplied in various lengths up to 828 inches. All RTD sensors 48 inches and longer will be shipped in a coiled configuration. The sensors on this page can be provided with a (4 to 20) mA Transmitter integrally mounted inside the available enclosures.



ORDER CODES

Example Order Number:

1	2		3		4	5	
2290L	**3(23)3**	**-**	**2880**	**-**	**8HN**	**63**	**T440**

1 RTD Averaging Sensor

CODE	DESCRIPTION
2290L	3-wire continuous averaging RTD sensor

2 Sheath Material and Diameter

CODE	DESCRIPTION	
	DIAMETER (inches)	MATERIAL
3(23)3	3/16	Copper
4(23)3	1/4	Copper
383	3/16	316 SS
483	1/4	316 SS

3 Length

AVAIL. LENGTHS (inches)	DIAMETER O.D. (inches)	BENDABILITY
12	3/16, 1/4	Rigid
24	3/16, 1/4	Rigid
36	3/16, 1/4	Rigid
37 to 324	3/16, 1/4	Bendable
325 to 828	1/4	Bendable
Specify length in inches using 3 digits.		

Initial averaging RTD accuracy calculation: ± [1.3 + 0.005 |t|] ºC
|t| = Value of temperature without regard to sign, ºC

TEMPERATURE	ºC	ºF	TEMPERATURE	ºC	ºF
0 ºC [32 ºF]	1.3	2.3	60 ºC [140 ºF]	1.6	2.9
20 ºC [68 ºF]	1.4	2.5	80 ºC [176 ºF]	1.7	3.1
40 ºC [104 ºF]	1.5	2.7	100 ºC [212 ºF]	1.8	3.2

4 Head Mounting Fittings

CODE	DESCRIPTION
8HN	1/2" x 1/2" NPT stainless steel hex nipple
6HN	1/2" x 1/2" NPT steel hex nipple

5 Terminations

CODE	DESCRIPTION
22(06)	6" individual Teflon® leads with terminal pins
31	Aluminum screw-cover head
49	Flip-top aluminum head
47	2" x 4" electrical handibox
Options	
HT	Floor flange threaded on hex
T-440	4-20 mA head-mounted transmitter (see instrument section)

Teflon® is a registered trademark of E. I. du Pont de Nemours and Company.

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TC-4100 Series, TC-4200 Series

Bulb Thermostats & Return Air Thermostats General Instructions

APPLICATION

For on-off control of media temperature in ducts, tanks, liquid lines, etc.

SPECIFICATIONS

Setpoint Dial Range: Dial plate is marked as °F on one side and °C on the other. See Table-2 for specific ranges.
Sensing Element: Liquid-filled copper.
Differential: See Table-2.
Dual Bulb Units: One bulb senses the controlled media; the second bulb senses the outside air temperature. The temperature of the controlled media increases as outside air temperature decreases.
Ambient Temperature Limits:
Case,
Shipping -40 to 160°F (-40 to 71°C).
Operating -40 to 150°F (-40 to 65°C): except return air bulb unit, -40 to 140°F (-40 to 60°C).
Bulb, See Table-2.
Electrical Switch: Snap action SPDT, one per stage.
Ratings, See Table-1.
Connections: Coded screw terminals.
Cover: All metal with 1/2" to 3/4" conduit openings.
Case Locations: NEMA Type 1 indoor only.
Mounting: Case can be mounted in any position. See ACCESSORIES for bulb mounting kits (order separately).
Dimensions:
Case, 4-5/8" high x 2-1/4" wide x 2" deep (117 mm x 57 mm x 51 mm)
Element and Capillary, See Table-2.

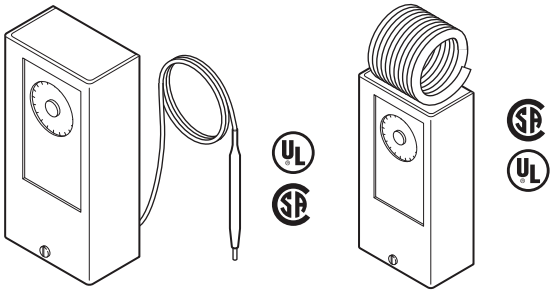
ACCESSORIES

AT-201	Copper bulb well requires AT-209
AT-203	Stainless steel bulb well requires AT-209
AT-206	Copper bulb well
AT-208	Duct mounting kit
AT-209	Bulb mounting kit
AT-210	Concealed adjustment plate
AT-211	Outside bulb shield

Table-1 Maximum Electrical Rating (All units except TC-4115*)

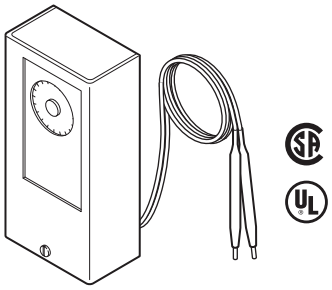
Switch Rating (50/60 Hz)	24V	120V	240V
Full Load Amps	9.8	9.8	8.0
Locked Rotor Amps	58.8	58.8	48.0
Pilot Duty VA	60	360	360
Non-Inductive Amps (Resistive)			
Single Stage	22	22	22
Two Stage	16	16	8.0

* TC-4115 for TAC System 8000 and applications requiring less than one (1) amp. Electrical Rating: 1.0 amp at 24 Vac; 0.25 amp at 24 Vdc.



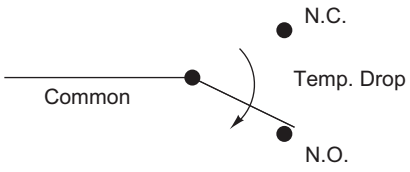
Typical Single Bulb

Typical Return Air Bulb



Typical Dual Bulb

Typical Single Stage



N.O. makes ON temperature drop

Typical Two Stage

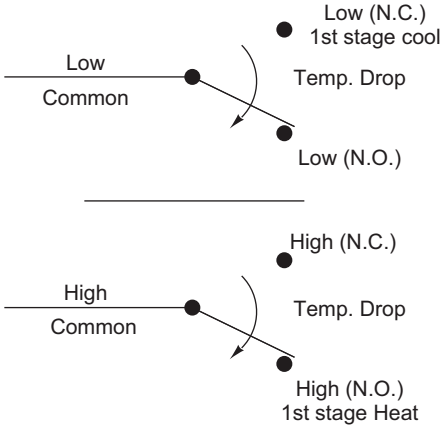


Figure-1 Switch Action and Terminal Identification.

Printed in U.S.A. 11/09
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Table-2 Specifications.

Part Number	Type	Setpoint Adjustment Range °F (°C)	Dual[a] Bulb Ratio	Dimensions			Differential °F (°C)	Safe Bulb Temperature Range °F (°C)
				Capillary Copper ft. (m)	Bulb Copper in. (mm) Indoor	Bulb Copper in. (mm) Outdoor		
TC-4111	Single Stage Single Bulb	-40 to 120 (-40 to 49)		6 (1.8)	3/8 x 4 (9.5 x 102)		Factory Set 3 (2) Adj. 3 to 16 (2 to 9)	-40 to 170 (-40 to 77)
TC-4111-020				20 (6)				
TC-4112		100 to 260 (38 to 127)		6 (1.8)				-40 to 310 (-40 to 154)
TC-4115[b]		-40 to 120 (-40 to 49)						-40 to 170 (-40 to 77)
TC-4121				10 (3) Armored				
TC-4122		100 to 260 (38 to 127)						-40 to -310 (-40 to 154)
TC-4123		190 to 350 (88 to 176)						-40 to 400 (-40 to 204)
TC-4151	Single Stage Dual Bulb	70 to 120 (21 to 49)	1:1-1/2[c]	30 (9) Each Bulb	3/8 x 4 (9.5 x 102)	3/8 x 5-1/2 (9.5 x 140)	Factory Set 3 (2) Adj. 1-1/2 to 10 (1 to 5)	Total of indoor and outdoor temperatures must not exceed 280 (138)
TC-4152			1:1		3/8 x 4 (9.5 x 102)	3/8 x 4 (9.5 x 102)	Factory Set 3 (2) Adj. 3 to 16 (2 to 9)	
TC-4166	Single Stage Return Air Bulb	50 to 90 (10 to 32)		None	Coiled 2-1/2 x 2 (64 x 51)		Fixed 2 (1)	-40 to 145 (-40 to 63)
TC-4211	Two Stage Single Bulb	-40 to 120 (-40 to 49)		6 (1.8)	3/8 x 4 (9.5 x 102)		Per Stage Fixed 3 (2) Between Stages Set 3 (2) Adj. 2 to 10 (1 to 5)	-40 to 170 (-40 to 77)
TC-4221				10 (3) Armored				
TC-4222		100 to 260 (38 to 127)						-40 to 310 (-40 to 154)
TC-4223		190 to 350 (88 to 176)						-40 to 400 (-40 to 204)
TC-4251	Two Stage Dual Bulb	70 to 120 (21 to 49)	1:1-1/2[c]	30 (9) Each Bulb	3/8 x 4 (9.5 x 102)	3/8 x 5-1/2 (9.5 x 140)	Per Stage Fixed 3 (2) Between Stages Set 3 (2) Adj. 1.5 to 6.5 (1 to 4)	Total of indoor and outdoor temperatures must not exceed 280 (138)
TC-4252			1:1		3/8 x 4 (9.5 x 102)	3/8 x 4 (9.5 x 102)	Per Stage Fixed 3 (2) Between Stages Set 3 (2) Adj. 2 to 10 (1 to 5)	
TC-4266	Two Stage Return Air Bulb	50 to 90 (10 to 32)		None	Coiled 2-1/2 x 2 (64 x 51)		Each Stage Fixed 2 (1) Between Stages Set 3 (2) Adj. 1 to 5 (0.5 to 3)	-40 to 145 (-40 to 63)

[a] First number of reset ratio typically indicates outdoor air temperature change required to increase the setpoint by the second number.
[b] See Electrical Rating.
[c] For 1-1/2:1 ratio, reverse bulbs and use extra dial supplied with unit.

Table-3 Ratio Selection Table.

Outdoor Temperature in °F	Ratio	Change in Water Temperature for Different Ratios as Outdoor Temperature Drops from 70°F to Design Temperature					
		Dial Set at 70°F	Dial Set at 80°F	Dial Set at 90°F	Dial Set at 100°F	Dial Set at 110°F	Dial Set at 120°F
-30	1 to 1-1/2 1 to 1 1-1/2 to 1	70 to 220 70 to 170 70 to 137	80 to 230 80 to 180 80 to 147	90 to 240 90 to 190 90 to 157	100 to 250 100 to 200 100 to 167	110 to 260 110 to 210 —	120 to 270 120 to 220 —
-20	1 to 1-1/2 1 to 1 1-1/2 to 1	70 to 205 70 to 160 70 to 130	80 to 215 80 to 170 80 to 140	90 to 225 90 to 180 90 to 150	100 to 235 100 to 190 100 to 160	110 to 245 110 to 200 —	120 to 255 120 to 210 —
-10	1 to 1-1/2 1 to 1 1-1/2 to 1	70 to 190 70 to 150 70 to 123	80 to 200 80 to 160 80 to 133	90 to 210 90 to 170 90 to 143	100 to 220 100 to 180 100 to 153	110 to 230 110 to 190 —	120 to 240 120 to 200 —
0	1 to 1-1/2 1 to 1 1-1/2 to 1	70 to 175 70 to 140 70 to 117	80 to 185 80 to 150 80 to 127	90 to 195 90 to 160 90 to 137	100 to 205 100 to 170 100 to 147	110 to 215 110 to 180 —	120 to 225 120 to 190 —
+10	1 to 1-1/2 1 to 1 1-1/2 to 1	70 to 160 70 to 130 70 to 110	80 to 170 80 to 140 80 to 120	90 to 180 90 to 150 90 to 130	100 to 190 100 to 160 100 to 140	110 to 200 110 to 170 —	120 to 210 120 to 180 —
+20	1 to 1-1/2 1 to 1 1-1/2 to 1	70 to 145 70 to 120 70 to 103	80 to 155 80 to 130 80 to 113	90 to 165 90 to 140 90 to 123	100 to 175 100 to 150 100 to 133	110 to 185 110 to 160 —	120 to 195 120 to 170 —
+30	1 to 1-1/2 1 to 1 1-1/2 to 1	70 to 130 70 to 110 70 to 97	80 to 140 80 to 120 80 to 107	90 to 150 90 to 130 90 to 117	100 to 160 100 to 140 100 to 127	110 to 170 100 to 150 —	120 to 180 120 to 160 —

°C = (°F - 32) 5/9.

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DUAL BULB SELECTION

On the dual bulb units, indoor and outdoor bulbs are determined by the ratio selected (see Table-2). Ratio refers to the outdoor air temperature change compared to the water temperature change. The dial setpoint is the water temperature setpoint when the outdoor temperature is 70°F.

To select ratio, it is necessary to know only: (1) outdoor design temperature, (2) maximum water temperature at outdoor design temperature, and (3) desired water temperature at 70°F outdoors. Use Table-3 to determine the required ratio based on this information and set the dial per item (3).

Note: If a 1-1/2:1 ratio is selected, the extra dial supplied with the unit must be used.

Example: Select ratio for an installation with a -10°F design temperature and estimated supply water temperature of 75°F at 70°F outdoors and 125°F at -10°F outdoors. From Table-3, -10°F for 1-1/2:1 ratio, note by interpolation (70°F to 123°F with dial at 70°F, 80°F to 133°F with dial at 80°F) that water temperature varies from 75°F to 128°F as outdoor temperature drops from 70°F to -10°F.

For this application, the 1-1/2:1 ratio should be selected. The extra dial supplied with the unit would be used, and the dial set at 75°F.

PRE-INSTALLATION

Inspection

Visually inspect the carton for damage. If damaged, notify the appropriate carrier immediately. If undamaged, open the carton and visually inspect the device for obvious defects. Return damaged or defective products.

Required Installation Items

- Wiring diagram
- Tools (not provided):

  Volt-ohm meter

  Room temperature thermometer on °F or °C

  Appropriate screwdriver(s) for cover, terminals and mounting screws

  Appropriate drill and drill bit for mounting screws

INSTALLATION

Caution:

1. Installer must be a qualified, experienced technician.
2. Disconnect power supply before installation to prevent electrical shock and equipment damage.
3. Make all connections in accordance with the electrical wiring diagrams, and in compliance with national and local codes. *Use copper conductors only.*
4. Do not exceed ratings of the device.
5. Avoid locations where excessive moisture, corrosive fumes or vibrations are present.

Location

Locate the device allowing proper distance to the bulb location. The case can be mounted in any position. Refer to Figure-2 for case dimensions.

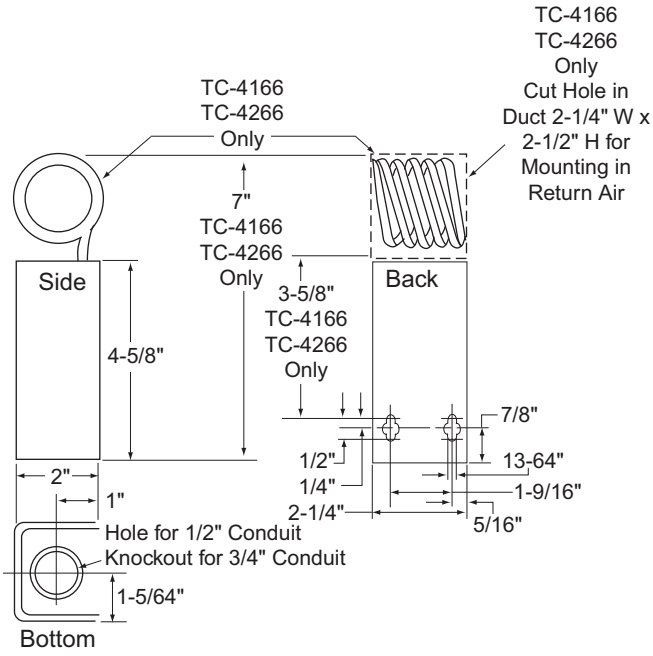

Figure-2 Case Dimensions.

Procedure for Remote Bulb Mounting

Air Bulb Models — Mounting in Return Air Duct

1. Remove cover and provide two holes for #10 round head screws using the housing as the template or by using the dimensions shown in Figure-2.
2. Partially insert the mounting screws in the screw holes. Fit the housing over the screws, slide housing down on the screws and tighten the screws.

Air Bulb Models — Mounting Outside of Return Air Duct

1. Prepare duct for mounting by cutting hole and providing mounting screw holes per Figure-2.
2. Fabricate a cover as shown in Figure-3.
3. Carefully roll bulbs toward back of unit and insert through 2-1/4" x 2-1/2" (57 mm x 64 mm) hole.
4. Remove cover and attach unit to duct with #10 screws.
5. Attach cover over 2-1/4" x 2-1/2" (57 mm x 64 mm) hole.

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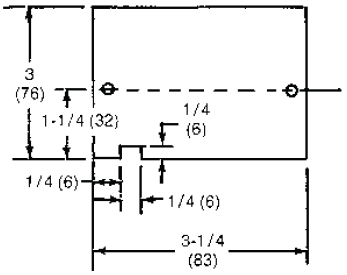

Figure-3 Field Supplied Duct Hole Cover Plate.

Duct and Outdoor Mounting

Maximum insertion length is 6 inches.

Duct: Install bulb with AT-208 kit as shown in Figure-4.

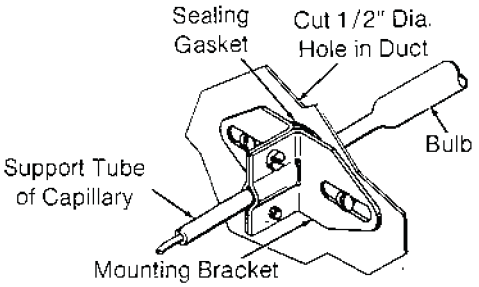

Figure-4 Duct Mounting with AT-208.

Outdoor: Install with AT-211 kit as shown in Figure-5.

1. Mount bulb to outside wall or surface with bulb clip.
2. Place shield over bulb and fasten to mounting surface.

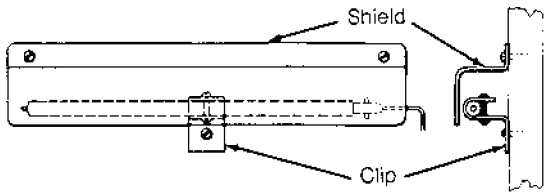

Figure-5 Outdoor Mounting with AT-211.

Bulb Mounting — Liquid Line and Tank

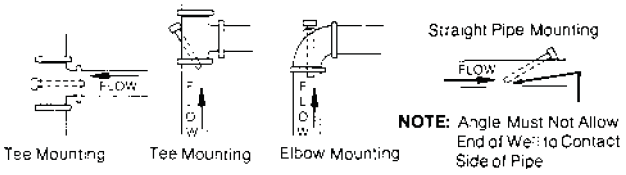

Figure-6 Bulb Mounting for Liquid Line and Tank.

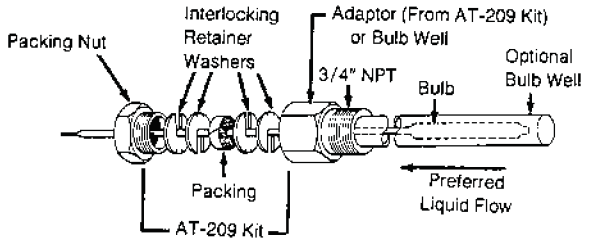

Figure-7 AT-201 or AT-203 Installation.

AT-201 or AT-203 Installation (see Figures-6 and 7):

1. Install bulb well or adaptor from AT-209 into 3/4" FNPT opening.
2. Place packing nut, washers and packing from AT-209 over bulb support section and insert bulb well or AT-209 adaptor.
3. Push interlocking washers and packing into well or adaptor and tighten packing nut until firmly sealed.

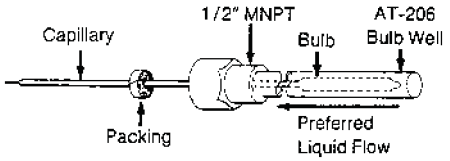

Figure-8 AT-206 Installation.

AT-206 Installation (see Figures-6 and 8):

1. Install AT-206 bulb well into 1/2" FNPT opening.
2. Place packing (included with AT-206) over bulb support section and insert bulb into well.
3. Push packing into nut on well using a screwdriver.

Concealed Setpoint and Lock Cover Screw

Order AT-210 concealed adjustment kit separately.

1. Peel off adhesive film from the concealed adjustment plate and place into the recess of cover.
2. Remove screw from cover.
3. Install lock cover screw provided with AT-210.

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Table-4 Bulb Mounting Installation Hardware And Application Limitations.

Part Number	Description	Mounting Fitting	Insertion Size in. (mm)	Application Limitations at 250°F (121°C) Fluid Temperature[a]		Installation per Figure
				Max. Recommended Velocity fps (m/s)	Max. Recommended Static Press. psig (kPa)	
AT-201[b]	Copper Bulb Well	3/4" MNPT	1/2 (13) dia. O.D. 9-1/2 (241) long	11 (3.3)	250 (1728)	7
AT-203[b]	Stainless Steel Bulb Well			20 (6.1)	500 (3448)	
AT-206	Copper Bulb Well	1/2" MNPT	1/2 (13) dia. O.D. 4-1/2 (114) long	11 (3.3)	250 (1728)	8

[a] Max. recommended fluid temperature is 350 F (177°C).
[b] Requires AT-209.

WIRING

The thermostat has one 1/2" to 3/4" conduit opening in the bottom of the housing. Terminal coding and switch action are shown in Figures-9 and 10.

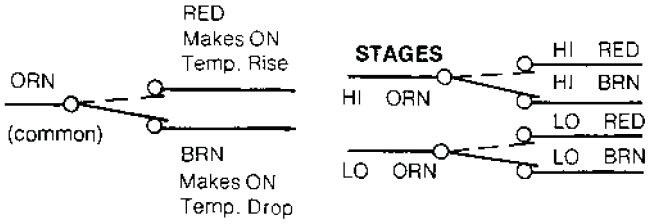

Figure-9 Terminal Coding and Switch Action.

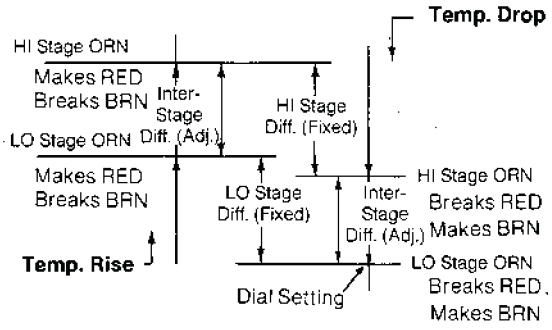

Figure-10 Two Stage Switch Sequence.

TYPICAL APPLICATIONS

Figures-11 and 12 show typical heating and cooling applications for single stage units. Figures-13 and 14 show typical heating and cooling applications for two stage units.

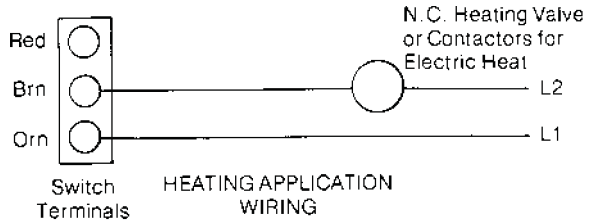

Figure-11 Typical Heating Application for Single Stage Units.

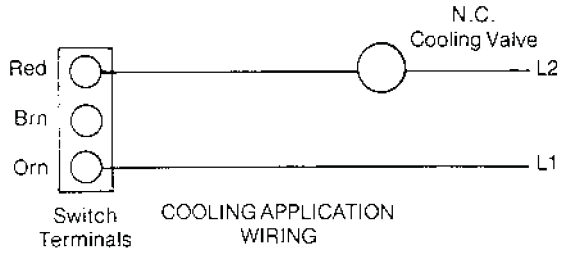

Figure-12 Typical Cooling Application for Single Stage Units.

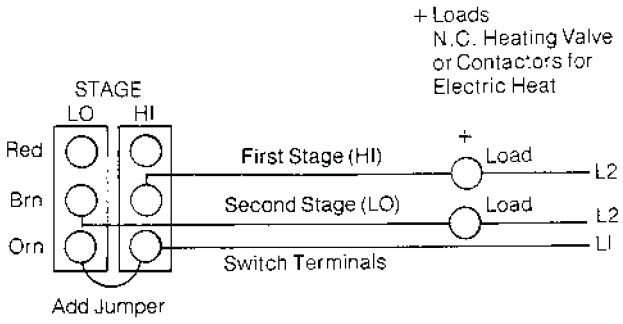

Figure-13 Typical Heating Application for Two Stage Units.

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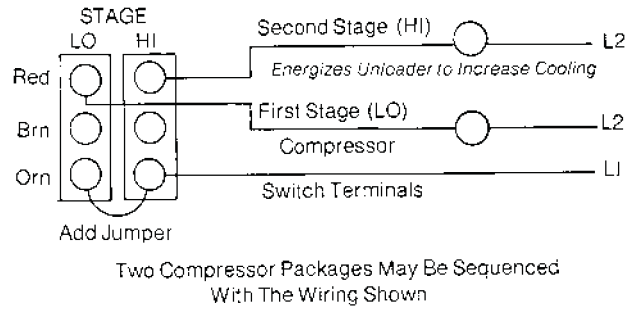

Figure-14 Typical Cooling Application for Two Stage Units.

CHECKOUT

After installing a thermostat, make an initial check of the switching action. Verify the switch action by listening to the switch contacts.

1. Turn the setpoint dial to a temperature above ambient. This should cause the thermostat to switch, making orange to brown.
2. Turn the setpoint dial setting down gradually. Orange to brown must break, making orange to red.
3. Compare the differential of the device to the differential shown on the performance charts by turning the dial. The differential of the device is the difference in dial reading between the make of orange to brown and the make of orange to red on single switch units.

ADJUSTMENTS

Setpoint

Screwdriver adjustment. Scales dual marked °F on front and °C on back. To change scale, remove spring retaining ring, select scale and replace retaining ring.

Differential

The differential is adjustable by turning the adjustor located on the side of the device (see Figure-15).

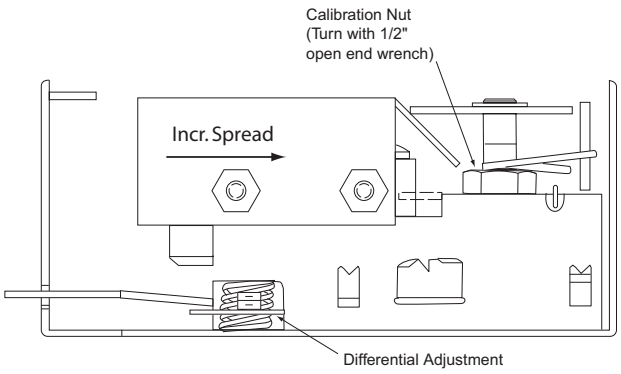

Figure-15 Adjustments.

Single Stage: Each line represents approximately 3°F (2°C) change.

Two Stage: Each notch represents approximately 2°F (1°C) change between stages. (Differential per switch is fixed.)

To adjust interstage differential:

1. Disconnect power to unit.
2. Remove cover.
3. Turn adjustor to approximately desired position.
4. Check out by turning dial and noting dial readings where switch contacts make.
5. After changing interstage differential, recalibrate. See CALIBRATION.

CALIBRATION

1. With all power disconnected, soak bulb(s) for 10 minutes at known temperature (must be 70°F for dual bulb).
2. Turn dial and note where switch contacts make.
3. Turn dial midway between click points.
4. Turn the calibration nut (located under dial) until the temperature of the bulb is indicated on the dial (see Figure-15).

Note: On two stage units follow above procedure. LO switch is first stage on cooling applications. HI switch is first stage on heating applications.

MAINTENANCE

Regular maintenance of the total system is needed to assure sustained optimum performance. Thermostats should be periodically inspected for dirt or blockage of air over the elements.

REPAIR

Field repair is not recommended. Replace defective device.

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AEROFIN
Heat Transfer Products

Date: 06/14/2013
Job Name: Thomas - Mt. Vernon, IN
System ID: PRE-CC-0FLEX rev A
Quote No. 130079-01

Model No.	Qty. In Face	FL INCH	Total Weight LBS.
W-11.0AW-30.0 X 26.0-8-0.5	1	26.00	278
Totals:	1		278

Coil Type: W
TF: 20
Row: 8
Fin: 11.00 / IN
Circuit: Half

Tube: 0.625 inch X 0.035 inch Copper Seamless Tubes , Belled
Fin Material: Aluminum Wave **Thickness:** 0.0095 IN.
Csg Material: 1-1/2" Leg with Stainless Stl Casings
Connection: (1) 1.5" Threaded Carbon Stl, Extended 5 inches,
Hdr Material: Standard Carbon Stl with Brazed Joints

Dwg: CA-W-100

Performance NV

Pressure: 29.50 IN HG Elevation: 387.0 FT

Airflow:	1,700.0	SCFM	**Water**		
System Face Area:	5.4	FT^2	Flow Rate:	23.61	GPM
Standard Face Velocity:	313.8	FPM	Entering Temp:	45.0	°F
Entering Dry Bulb Temp:	104.0	°F	Leaving Temp:	58.0	°F
Entering Wet Bulb Temp:	77.0	°F	Tube Velocity:	2.8	FPS
Leaving Dry Bulb Temp:	50.0	°F	Inside Surface Fouling:	0.0000	$HR{\cdot}FT^2{\cdot}°F/BTU$
Leaving Wet Bulb Temp:	50.0	°F			
Outside Surface Fouling:	0.0000	$HR{\cdot}FT^2{\cdot}°F/BTU$			
Sensible Heat Load:	99.1	MBH			
Total Heat Load:	153.4	MBH			

Losses

Air Friction:	0.65	IN H2O	Pressure Drop:	4.3	FT H2O

Comments:

Notes & Warnings:

51 Outside the scope of AHRI standard 410.
13 Pressure drop shown is based on belled tube ends.

AEROFIN
Heat Transfer Products

Date: 06/14/2013
Job Name: Thomas - Mt. Vernon, IN
System ID: Re-HC#1-0FLEX rev A
Quote No. 130079-01

Model No.	Qty. In Face	NTL INCH	Total Weight LBS.
BNF-10.0AW-20.6 X 26.0-2-1	1	26.00	56
Totals:	1		56

Coil Type: BNF
TF: 9
Row: 2
Fin: 10.00 / IN
Circuit: N/A

Tube: 0.625 inch X 0.035 inch Copper Seamless Tubes
Fin Material: Series 72B Aluminum
Csg Material: Standard with Stainless Stl Casings
Connection: See Drawing Carbon Stl, Extended 5 inches,
Hdr Material: Standard Carbon Stl with Silver Brazed Joints

Thickness: 0.01 IN.

Dwg: CA-140-3BNF-231

Performance NV

Pressure: 29.50 IN HG Elevation: 387.0 FT

Airflow:	1,700.0	SCFM
System Face Area:	3.2	FT^2
Standard Face Velocity:	528.5	FPM
Entering Dry Bulb Temp:	50.0	°F
Leaving Dry Bulb Temp:	146.0	°F
Outside Surface Fouling:	0.0000	$HR{\cdot}FT^{2}{\cdot}°F/BTU$
Sensible Heat Load:	176.5	MBH
Total Heat Load:	176.5	MBH

Saturated Steam

Steam Press:	96.0	PSIG
Steam Temp:	335.0	°F
Condensate Rate:	200.0	LB/HR
Inside Surface Fouling:	0.0000	$HR{\cdot}FT^{2}{\cdot}°F/BTU$

Losses
Air Friction: 0.12 IN H2O

Comments:

Notes & Warnings:

51 Outside the scope of AHRI standard 410.

AEROFIN
Heat Transfer Products

Date: 06/14/2013
Job Name: Thomas - Mt. Vernon, IN
System ID: Re-HC#2-0FLEX rev A
Quote No. 130079-01

Model No.	Qty. In Face	NTL INCH	Total Weight LBS.
BNF-12.0AW-20.6 X 26.0-1-1	1	26.00	51
Totals:	1		51

Coil Type: BNF
TF: 10
Row: 1
Fin: 12.00 / IN
Circuit: N/A

Tube: 0.625 inch X 0.035 inch Copper Seamless Tubes
Fin Material: Series 81B Aluminum
Csg Material: Standard with Stainless Stl Casings
Connection: See Drawing Carbon Stl, Extended 8 inches,
Hdr Material: Standard Carbon Stl with Silver Brazed Joints

Thickness: 0.01 IN.

Dwg: CA-140-3BNF-229

Performance NV

Pressure: 29.50 IN HG Elevation: 387.0 FT

Airflow:	1,700.0	SCFM
System Face Area:	3.2	FT^2
Standard Face Velocity:	528.5	FPM
Entering Dry Bulb Temp:	146.0	°F
Leaving Dry Bulb Temp:	195.0	°F
Outside Surface Fouling:	0.0000	$HR{\cdot}FT^{2}{\cdot}°F/BTU$
Sensible Heat Load:	90.4	MBH
Total Heat Load:	90.4	MBH

Saturated Steam

Steam Press:	96.0	PSIG
Steam Temp:	335.0	°F
Condensate Rate:	102.3	LB/HR
Inside Surface Fouling:	0.0000	$HR{\cdot}FT^{2}{\cdot}°F/BTU$

Losses
Air Friction: 0.09 IN H2O

Comments:

Notes & Warnings:

51 Outside the scope of AHRI standard 410.

AEROFIN
Heat Transfer Products

Date: 06/14/2013
Job Name: Thomas - Mt. Vernon, IN
System ID: Post-CC-0FLEX rev A
Quote No. 130079-01

Model No.	Qty. In Face	FL INCH	Total Weight LBS.
W-9.0AW-16.5 X 26.0-4-0.5	1	26.00	90
Totals:	1		90

Coil Type: W
TF: 11
Row: 4
Fin: 9.00 / IN
Circuit: Half

Tube: 0.625 inch X 0.035 inch Copper Seamless Tubes
Fin Material: Aluminum Wave
Csg Material: 3/4" Leg with Stainless Stl Casings
Connection: (1) 1.5" Threaded Carbon Stl, Extended 5 inches,
Hdr Material: Standard Carbon Stl with Brazed Joints

Thickness: 0.0095 IN.

Dwg: CA-W-101

Performance NV

Pressure: 29.50 IN HG Elevation: 387.0 FT

Airflow:	1,700.0	SCFM	**Water**		
System Face Area:	3.0	FT^2	Flow Rate:	11.03	GPM
Standard Face Velocity:	570.6	FPM	Entering Temp:	45.0	°F
Entering Dry Bulb Temp:	107.0	°F	Leaving Temp:	58.0	°F
			Tube Velocity:	2.2	FPS
Leaving Dry Bulb Temp:	68.0	°F	Inside Surface Fouling:	0.0000	$HR{\cdot}FT^2{\cdot}°F/BTU$
Outside Surface Fouling:	0.0000	$HR{\cdot}FT^2{\cdot}°F/BTU$			
Sensible Heat Load:	71.7	MBH			
Total Heat Load:	71.7	MBH			

Losses

Air Friction:	0.64	IN H2O	Pressure Drop:	2.0	FT H2O

Comments:

Notes & Warnings:

51 Outside the scope of AHRI standard 410.

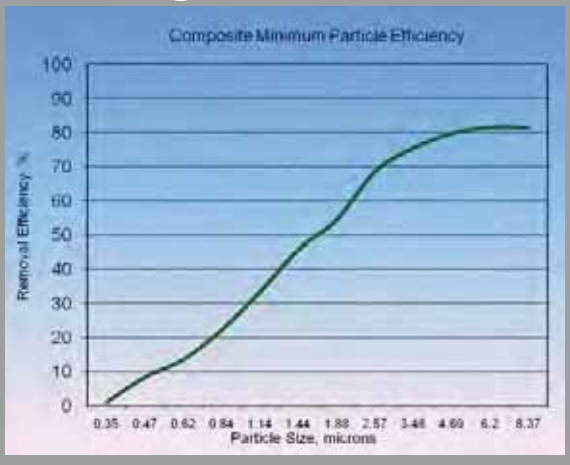
5
Filters

30/30®

High-Capacity MERV 8 Pleated Panel Filter

ENERGY COST INDEX ★★★★★

The best performing pleated panel filter — guaranteed!



Composite minimum efficiency values of the 30/30 when evaluated per ASHRAE Standard 52.2-2007. The 30/30 has a MERV of 8 and MERV-A of 8 when tested per appendix J.

The Camfil Farr 30/30 has set the industry standard for pleated panel filters since 1963. With over 45 design enhancements, it continues to provide the industry's best value for medium efficiency filtration.

Setting the standard by which other pleated filters are judged, modern media manufacturing techniques and proprietary technological advancements ensure that the Camfil Farr 30/30 is:

- *Guaranteed to perform at the rated efficiency, or better, throughout the life of the filter.*
- *Guaranteed to last longer than any other pleated panel filter available.*

Performing at MERV 8, using a mechanical particle capture principle, the 30/30 will not drop in efficiency while in service as will other pleated panel filters that incorporate an electret charge to obtain a MERV 8 value.

Its radial pleat design provides the longest life and lowest average pressure drop reducing the number of filter changes so your facility will use less fan power to move air through the filter.

The high wet-strength beverage frame and welded wire media backing provide structural integrity in any type of HVAC application virtually eliminating the additional costs associated with filter bypass or filter failure.

Available in 1", 2" or 4" deep configurations, the 30/30 is ideal for commercial, industrial, institutional or any other application where the ultimate level of protection of equipment and indoor air quality is a concern.

The Camfil Farr 30/30 has an Energy Cost Index (ECI) of five stars, the highest performance rating available.

[1] A 5-Star rating indicates that this filter performs in the top 20% of all products of similar construction in the HVAC industry. Factors of consideration include maintained efficiency, energy usage and resistance to air flow. Detailed evaluation information is available from your Camfil Farr sales outlet or on the web at www.camfilfarr.com.

Exclusive MERV 8 Performance from Camfil Farr Media

The highest media weight, more than any other pleated panel filter, and uniform lofting for high dust holding capacity, ensure that the 30/30 will last longer in any HVAC application.

The 30/30 media is manufactured from a proprietary blend of fibers that incorporate a mechanical principle of particle capture. The filter does not require an electret charge which would dissipate and reduce filter's efficiency after minimal hours of operation in a system. The media is lofted to a uniform depth to enhance the depth-loading characteristic and ensure the longest life of any pleated filter available. The high-loft also offers a lower resistance to airflow so fan horsepower required to move air through the filter is minimized. Camfil Farr evaluates the quality of all incoming raw materials to maintain product integrity as part of a rigorous quality control program.

Welded Wire Grid Maintains Radial Pleat Design

The media is formed into a radial pleat for uniform dust loading and full use of the media area. V-style pleats blind while loading preventing full utilization of the media area and increasing the filters pressure drop resulting in increased energy usage. A welded wire grid, spot welded on one-inch centers maintains each radial pleat and maintains media stability through varying airflows.

Rounded radial pleats, instead of v-shape pleats, allow full usage of media area.

Diagonal support members, glued to each pleat at its apex, helps maintain pleat stability and filter rigidity.

High Wet-Strength Beverage Board Frame

The high wet-strength beverage board frame, the thickest board in the industry, creates a stable and non-yielding media pack. Filter bypass is virtually eliminated because the filter fits securely in the filter holding mechanism. The media is bonded to the frame ensuring that all of the air seen by the filter will be treated by the filter. Diagonal support members are bonded to each pleat to maintain pleat spacing and add stability to the pack through bridge-style engineering. The 30/30 is guaranteed to 2.0" w.g. of pressure filter without failure. Costly filter blowouts and compromising of HVAC system cleanliness is eliminated.

ISO 9001:2008 Certified Quality Control

Every 30/30 filter is identified on the frame with a unique manufacturing code that allows us to analyze every component of construction from raw materials to the point where the product is boxed for shipping. Filters are inspected for structural integrity so they are capable of operating in the harshest HVAC system conditions. The adhesiveness of diagonal support members to pleat apexes is inspected so pleat spacing is uniform to provide longer filter life. Each media lot is laboratory tested to confirm consistent performance and individual filters are submitted from each manufacturing facility on a strict schedule for ASHRAE 52.2 testing in our world-class testing facility.

The standard of the industry, by Camfil Farr.

Used in many systems as a prefilter, the 30/30 extends the life of final filters by capturing larger contaminant and thereby allowing the final filters to concentrate on removing smaller particles such as those that are respirable and can cause lung damage. The 30/30 is also an excellent choice when applied as the only filter in a system to keep coils clean and maintain efficiency, and protect building occupants from contaminants of annoyance such as pollen, plant spores, atmospheric dusts and other indoor air irritants.

Unprecedented Industry Guarantee

If our filters don't outlast and outperform your current filters, we'll replace them, FREE.
For guarantee details and a distributor list, visit www.camfilfarr.com.

PERFORMANCE DATA

2” Deep Filter (actual filter depth 1.75”)

Part Number	Nominal Depth (inches)	Nominal Size (inches)	Actual Size (inches)			Initial Resistance (inches w.g.)	Airflow Capacity (cfm)	Total Media Area (sq. ft.)	Pleats per Linear Foot
			Depth	Height	Width				
049880-019	2	16 x 16	1.75	15.50	15.50	0.31	890	7.8	15 pleats per linear foot
049880-008		20 x 10		19.50	9.50		700	6.0	
049880-009		20 x 14		19.50	13.50		975	8.3	
049880-007		20 x 12		19.50	11.88		835	7.4	
049880-011		20 x 15		19.50	14.50		1045	9.3	
049880-001		20 x 16		19.50	15.50		1100	9.9	
049880-013		20 x 18		19.50	17.50		1250	10.8	
049880-002		20 x 20		19.50	19.50		1390	11.9	
402271-007		20 x 30		19.50	29.50		2085	18.2	
049880-006		24 x 12		23.38	11.38		1000	8.4	
049880-015		24 x 18		23.50	17.50		1500	13.0	
049880-012		24 x 20		23.50	19.50		1670	14.3	
049880-005		24 x 24		23.38	23.38		2000	17.3	
049880-010		25 x 14		24.50	13.50		1220	10.4	
049880-020		25 x 15		24.50	14.50		1300	11.6	
049880-016		24 x 16		24.50	15.50		1335	11.8	
049880-004		25 x 16		24.50	15.50		1390	12.4	
049880-014		25 x 18		24.50	17.50		1565	13.5	
049880-003		25 x 20		24.50	19.50		1740	14.9	
049880-018		25 x 25		24.50	24.50		2170	19	

1” Deep Filter (actual filter depth 0.88”)

Part Number	Nominal Depth (inches)	Nominal Size (inches)	Actual Size (inches)			Initial Resistance (inches w.g.)	Airflow Capacity (cfm)	Total Media Area (sq. ft.)	Pleats per Linear Foot
			Depth	Height	Width				
404207-003	1	10 x 10	0.88	9.50	9.50	0.23	240	1.6	16 pleats per linear foot
054862-025		12 x 12		11.50	11.50		350	2.5	
404207-005		16 x 12		15.50	11.50		470	3.3	
054862-012		16 x 16		15.50	15.50		620	4.3	
054862-009		20 x 7		19.50	6.50		340	2.4	
054862-016		20 x 10		19.50	9.50		490	3.3	
054862-019		20 x 12		19.50	11.50		580	4.1	
054862-006		20 x 14		19.50	13.50		680	4.6	
054862-008		20 x 15		19.50	14.50		730	5.1	
054862-001		20 x 16		19.50	15.50		780	5.4	
054862-020		20 x 18		19.50	17.50		880	6.1	
054862-002		20 x 20		19.50	19.50		970	6.6	
054862-021		22 x 22		21.50	21.50		1180	8.2	
054862-022		24 x 10		23.50	9.50		580	4.0	
054862-010		24 x 12		23.50	11.50		700	4.9	
404207-004		24 x 14		23.50	13.50		820	5.5	
054862-015		24 x 16		23.50	15.50		970	6.7	
054862-028		24 x 18		23.50	17.50		1050	7.3	
054862-011		24 x 20		23.50	19.50		1165	8.0	
054862-005		24 x 24		23.50	23.50		1400	9.8	
054862-023		25 x 10		24.50	9.50		610	4.1	
054862-024		25 x 12		24.50	11.50		730	5.2	
054862-007		25 x 14		24.50	13.50		850	5.7	
054862-013		25 x 15		24.50	14.50		910	6.4	
054862-004		25 x 16		24.50	15.50		970	6.7	
054862-017		25 x 18		24.50	17.50		1100	7.6	
054862-003		25 x 20		24.50	19.50		1215	8.3	
054862-014		25 x 25		24.50	24.50		1520	10.5	

PERFORMANCE DATA (continued)

4” Deep Filter (actual filter depth 3.75”)

Part Number	Nominal Depth (inches)	Nominal Size (inches)	Actual Size (inches)			Initial Resistance (inches w.g.)	Airflow Capacity (cfm)	Total Media Area (sq. ft.)	Pleats per Linear Foot
			Depth	Height	Width				
059413-004	4	20 x 16	3.75	19.38	15.38	0.27	1100	15.7	11 pleats per linear foot
059413-003		20 x 20		19.38	19.38		1390	18.9	
059413-002		24 x 12		23.38	11.38		1000	13.9	
059413-009		24 x 18		23.38	17.38		1500	20.2	
059413-008		24 x 20		23.38	19.38		1670	22.7	
059413-001		24 x 24		23.38	23.38		2000	27.7	
059413-005		25 x 16		24.38	15.38		1390	19.7	
059413-006		25 x 20		24.38	19.38		1740	23.6	
059413-010		25 x 25		24.38	24.38		2170	30.0	
059413-007		25 x 29		24.38	28.38		2520	35.4	

Data Notes:
1.0” w.g. recommended final resistance for all depths. System design may dictate an alternative changeout point. Contact factory for guidance.
The 30/30 has been listed by Underwriters Laboratories as UL 900.
Maximum operating temperature 200º F (93º C).
2” and 4” deep filters rated at 250 feet per minute (fpm) medium and 500 fpm high. 1” deep filter’s rated at 175 fpm medium and 350 fpm high.
For product specification in RTF format please go to www.camfilfarr.com.

4” deep 30/30 is available with a header for side-access housing installation. Request Product Sheet 1003.

Specification

1.0 General

1.1 - Air filters shall be medium efficiency ASHRAE pleated panels consisting of cotton and synthetic media, welded wire media support grid, and beverage board enclosing frame.
1.2 - Sizes shall be noted on drawings or other supporting materials.

2.0 Construction

2.1 - Filter media shall be a cotton and synthetic blend, lofted to a uniform depth of 0.15”, and formed into a uniform radial pleat.
2.2 - A welded wire grid, spot-welded on one-inch centers and treated for corrosion resistance shall be bonded to the downstream side of the media to maintain radial pleats and prevent media oscillation.
2.3 - An enclosing frame of no less than 28-point high wet-strength beverage board shall provide a rigid and durable enclosure. The frame shall be bonded to the media on all sides to prevent air bypass. Integral diagonal support members on the air entering and air exiting side shall be bonded to the apex of each pleat to maintain uniform pleat spacing in varying airflows.

3.0 Performance

3.1 - The filter shall have a Minimum Efficiency Reporting Value of MERV 8 when evaluated under the guidelines of ASHRAE Standard 52.2. It shall also have a MERV-A of 8 when tested per Appendix J of the same standard. The media shall maintain or increase in efficiency over the life of the filter.
3.2 - Initial resistance to airflow shall not exceed 0.23”, 0.31” or 0.27” w.g. at an airflow of 350, 500 or 500 fpm on 1”, 2” or 4” deep models respectively.
3.3 - The filter shall have an Energy Cost Index (ECI) value of five stars.
3.4 - Filter shall be listed UL 900 by Underwriters Laboratories.
3.5 - Manufacturer shall provide evidence of facility certification to ISO 9001:2008.
3.6 - Manufacturer shall guarantee the integrity of the filter pack to 2.0” w.g.

Supporting Data - Provide product test report including all details as prescribed in ASHRAE Standards 52.2, including Appendix J.

Air filters shall be Camfil Farr 30/30 or equal.

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✓	NOMINAL SIZE (INCH)	ACTUAL SIZE H	ACTUAL SIZE W	AIRFLOW CAPACITY (CFM)	WEIGHT (LBS)
	20 X 16 X 1	19.50	15.50	780	0.60
	20 X 20 X 1	19.50	19.50	970	0.75
	25 X 20 X 1	24.50	19.50	1215	0.94
	25 X 16 X 1	24.50	15.50	970	0.75
	24 X 24 X 1	23.50	23.50	1400	1.08
	20 X 14 X 1	19.50	13.50	680	0.53
	25 X 14 X 1	24.50	13.50	850	0.66
	20 X 15 X 1	19.50	14.50	730	0.56
	20 X 7 X 1	19.50	6.50	340	0.30
	24 X 12 X 1	23.50	11.50	700	0.54
	24 X 20 X 1	23.50	19.50	1170	0.90
	16 X 16 X 1	15.50	15.50	620	0.48
	25 X 15 X 1	24.50	14.50	910	0.70
	25 X 25 X 1	24.50	24.50	1520	1.17
	24 X 16 X 1	23.50	15.50	930	0.72
	20 X 10 X 1	19.50	9.50	490	0.38
	25 X 18 X 1	24.50	17.50	1100	0.84
	20 X 12 X 1	19.50	11.50	580	0.45
	20 X 18 X 1	19.50	17.50	880	0.68
	22 X 22 X 1	21.50	21.50	1180	0.91
	24 X 10 X 1	23.50	9.50	580	0.45
	25 X 10 X 1	24.50	9.50	610	0.47
	25 X 12 X 1	24.50	11.50	730	0.56
	12 X 12 X 1	11.50	11.50	350	0.27
	24 X 18 X 1	23.50	17.50	1050	0.81

✓	NOMINAL SIZE (INCH)	ACTUAL SIZE H	ACTUAL SIZE W	AIRFLOW CAPACITY (CFM)	WEIGHT (LBS)
	24 X 24 X 4	23.38	23.38	2000	2.90
	24 X 12 X 4	23.38	11.38	1000	1.50
	20 X 20 X 4	19.38	19.38	1390	2.02
	20 X 16 X 4	19.38	15.38	1110	1.61
	25 X 16 X 4	24.38	15.38	1390	2.10
	25 X 20 X 4	24.38	19.38	1740	2.51
	25 X 29 X 4	24.38	28.38	2520	3.65
	24 X 20 X 4	23.38	19.38	1670	2.41
	24 X 18 X 4	23.38	17.38	1500	2.20
	25 X 25 X 4	24.38	24.38	2170	3.15
	24 X 16 X 4	23.38	15.38	1330	1.93

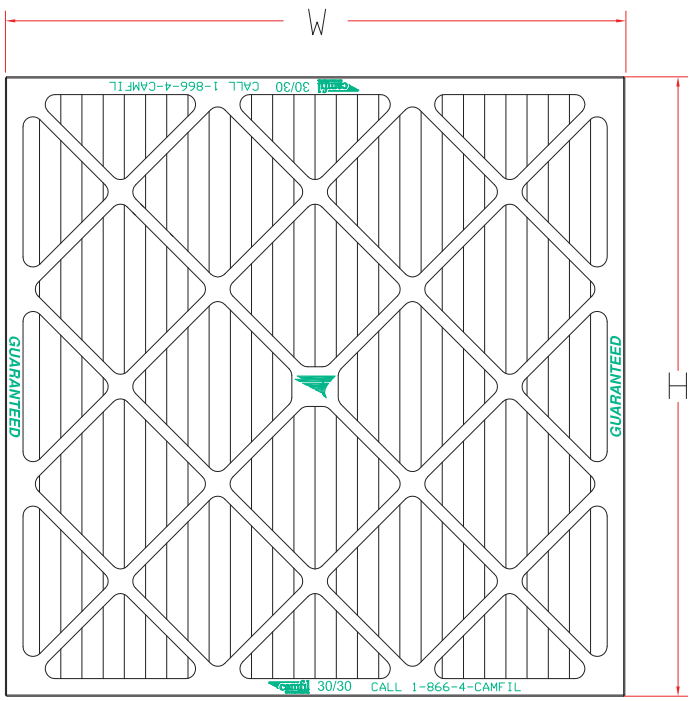
✓	NOMINAL SIZE (INCH)	ACTUAL SIZE H	ACTUAL SIZE W	AIRFLOW CAPACITY (CFM)	WEIGHT (LBS)
	20 X 16 X 2	19.50	15.50	1110	1.00
	20 X 20 X 2	19.50	19.50	1390	1.15
	25 X 20 X 2	24.50	19.50	1740	1.45
	25 X 16 X 2	24.50	15.50	1390	1.15
	24 X 24 X 2	23.38	23.38	2000	1.58
	24 X 12 X 2	23.38	11.38	1000	0.82
	20 X 12 X 2	19.50	11.88	835	0.70
	20 X 10 X 2	19.50	9.50	700	0.65
	20 X 14 X 2	19.50	13.50	975	0.76
	25 X 14 X 2	24.50	13.50	1220	1.00
	20 X 15 X 2	19.50	14.50	1045	0.85
	24 X 20 X 2	23.50	19.50	1670	1.35
	20 X 18 X 2	19.50	17.50	1250	1.10
	25 X 18 X 2	24.50	17.50	1565	1.30
	24 X 18 X 2	23.50	17.50	1500	1.25
	24 X 16 X 2	23.50	15.50	1335	1.00
	25 X 25 X 2	24.50	24.50	2170	1.71
	16 X 16 X 2	15.50	15.50	890	0.67
	25 X 15 X 2	24.50	14.50	1300	0.98

GENERAL NOTES:

1. MEDIUM EFFICIENCY, MERV 8 PANEL PLEATED DISPOSABLE FILTER. EFFICIENCY IS TESTED IN ACCORDANCE WITH ASHRAE 52.2-(LATEST REV).
2. AVAILABLE SIZES (NOMINAL) AND EFFICIENCIES: SEE TABULATION BLOCK.
3. SEE CAMFIL FARR BULLETIN 1002-(LATEST REV.) AND PRODUCT RTF SPECIFICATIONS FOR OTHER FEATURES, CONSTRUCTION AND PERFORMANCE CHARACTERISTICS.
4. FILTER THICKNESS:
   1" NOMINAL = .88" ACTUAL
   2" NOMINAL = 1.75" ACTUAL
   4" NOMINAL = 3.75" ACTUAL
5. FILTER CLASSIFIED AS UL 900

PERFORMANCE NOTES:

1. SEE TABULATION BLOCK FOR AIRFLOW CAPACITY.
2. CAMFIL FARR RECOMMENDS FILTER TO BE INSTALLED WITH THE PLEATS RUNNING PARALLEL TO HEIGHT DIMENSION.



MFG. DWGS. 054862, 049880 & 059413

REV	DATE	DESCRIPTION	EWO	DFT	CK	APP
X	05/16/12	REVISED	14955-BB	SS	SM	SM
A	08/15/72	FIRST ISSUE	7680-N	–	–	–

camfil FARR

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DESCRIPTION
30/30 MERV 8 FILTER
.88, 1.75 & 3.75 THICK

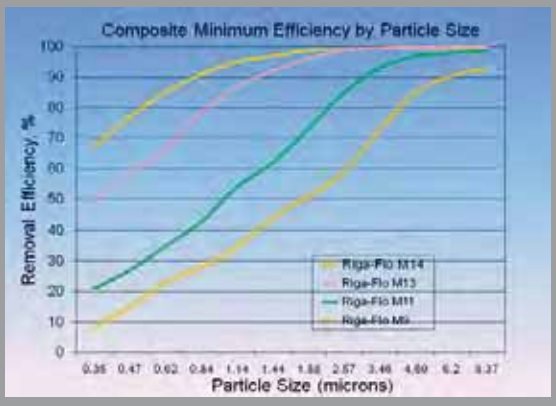
SHEET	DRAWING NUMBER	REV
1 OF 1	068766	X

Riga-Flo®

High-Lofted Supported Media Box Style Air Filter

ENERGY COST INDEX ★★★★☆

Full utilization of media area for longer life and performance that is not affected by varying system airflow.



Values are Minimum Efficiency Reporting Values (MERV) when evaluated per ASHRAE Standard 52.2.

The Camfil Farr Riga-Flo® provides high efficiency ASHRAE air filtration performance in a compact, supported media design. The materials of construction preclude contaminant amplification, as all components are inert to supporting the growth of captured bacteria or other viable contaminants. The Riga-Flo:

- Is available in four standard efficiencies — MERV 9, MERV 11, MERV 13 and MERV 14 per ASHRAE Standard 52.2. The Riga-Flo has a MERV-A value of 9, 11, 13 or 14 when tested using the conditioning step as specified in Appendix J of the same Standard.
- Includes high-lofted, depth-loading, micro fine glass media for longer service life and uniform low resistance to airflow. Filtration efficiency is maintained throughout the life of the filter.
- Has a unique media backing to maintain fiber blanket uniformity and preclude media migration. The backing is bonded to the media to support and maintain tapered radial pleats, and prevent media oscillation during varying system airflows.
- Includes a continuous adhesive bond around the media pack to eliminate air bypass and ensure integrity to 10" w.g.
- Includes an enclosing frame of corrosion-resistant galvanized steel.
- Includes all-metal diagonal support braces to assure filter rigidity and media pack protection.
- Includes unique bridge style plastic contour stabilizers, mechanically fastened to the diagonal support braces, on the air entering and air exiting sides, to ensure pleat support through turbulent or varying airflows.
- Has an ECI[1] value of four stars.

The Riga-Flo's supported media is excellent for VAV systems or today's energy and disposal conscious HVAC applications.

[1] A 5-Star rating indicates that this filter performs in the top 20% of all products of similar construction in the HVAC industry. Factors of consideration include maintained efficiency, energy usage and resistance to air flow. Detailed evaluation information is available from your Camfil Farr sales outlet or on the web at www.camfilfarr.com.

Riga-Flo®

High-Lofted Supported Media Box Style Air Filter

Performance Data

Filter Model & Efficiency[1]	Part Number	Nominal Size (inches) (H X W X D)	Actual Dimensions (inches) (H X W X D)	Airflow Capacity (cfm)	Media Area (sq. ft.)	Initial Resistance (inches w.g.)	Part Number	Nominal Size (inches) (H X W X D)	Actual Dimensions (inches) (H X W X D)	Airflow Capacity (cfm)	Media Area (sq. ft.)	Initial Resistance (inches w.g.)
Riga-Flo M14 MERV 14 MERV-A 14	402994-003	24 X 24 X 12	23.38 X 23.38 X 11.50	2000	53.0	0.53	402993-003	24 X 24 X 6	23.38 X 23.38 X 5.88	1200	26.8	0.60
	402994-006	24 X 12 X 12	23.38 X 11.38 X 11.50	1000	26.5		402993-006	24 X 12 X 6	23.38 X 11.38 X 5.88	600	13.4	
	402994-009	24 X 20 X 12	23.38 X 19.38 X 11.50	1670	43.1		402993-009	24 X 20 X 6	23.38 X 19.38 X 5.88	995	21.8	
	402994-012	20 X 20 X 12	19.38 X 19.38 X 11.50	1400	35.8		402993-012	20 X 20 X 6	19.38 X 19.38 X 5.88	840	18.1	
Riga-Flo M13 MERV 13 MERV-A 13	402994-002	24 X 24 X 12	23.38 X 23.38 X 11.50	2000	53.0	0.41	402993-002	24 X 24 X 6	23.38 X 23.38 X 5.88	1200	26.8	0.43
	402994-005	24 X 12 X 12	23.38 X 11.38 X 11.50	1000	26.5		402993-005	24 X 12 X 6	23.38 X 11.38 X 5.88	600	13.4	
	402994-008	24 X 20 X 12	23.38 X 19.38 X 11.50	1670	43.1		402993-008	24 X 20 X 6	23.38 X 19.38 X 5.88	995	21.8	
	402994-011	20 X 20 X 12	19.38 X 19.38 X 11.50	1400	35.8		402993-011	20 X 20 X 6	19.38 X 19.38 X 5.88	840	18.1	
Riga-Flo M11 MERV 11 MERV-A 11	402994-001	24 X 24 X 12	23.38 X 23.38 X 11.50	2000	53.0	0.31	402993-001	24 X 24 X 6	23.38 X 23.38 X 5.88	1200	26.8	0.20
	402994-004	24 X 12 X 12	23.38 X 11.38 X 11.50	1000	26.5		402993-004	24 X 12 X 6	23.38 X 11.38 X 5.88	600	13.4	
	402994-007	24 X 20 X 12	23.38 X 19.38 X 11.50	1670	43.1		402993-007	24 X 20 X 6	23.38 X 19.38 X 5.88	995	21.8	
	402994-010	20 X 20 X 12	19.38 X 19.38 X 11.50	1400	35.8		402993-010	20 X 20 X 6	19.38 X 19.38 X 5.88	840	18.1	

Riga-Flo MERV 9, as noted below, includes a wire backing on the media.												
Riga-Flo M9 MERV 9 MERV-A 9	096026-004	24 X 24 X 12	23.38 X 23.38 X 11.50	2000	53.0	0.36	097293-004	24 X 24 X 6	23.38 X 23.38 X 5.88	1200	26.8	Contact factory
	096026-008	24 X 12 X 12	23.38 X 11.38 X 11.50	1000	26.5		097293-008	24 X 12 X 6	23.38 X 11.38 X 5.88	600	13.4	
	096026-012	24 X 20 X 12	23.38 X 19.38 X 11.50	1670	43.1		097293-012	24 X 20 X 6	23.38 X 19.38 X 5.88	995	21.8	
	096026-016	20 X 20 X 12	19.38 X 19.38 X 11.50	1400	35.8		097293-016	20 X 20 X 6	19.38 X 19.38 X 5.88	840	18.1	

DATA NOTES:
6" deep units are only available with metal contour stabilizers.
MERV 9 models, 12" and 6" have a welded wire grid as media support backing.
** Recommended final resistance is 1.5" w.g. System design may dictate a lower change-out point.
[1] Respective listed efficiencies are MERV per ASHRAE 52.2 and MERV-A per Appendix J of that Standard.
Maximum continuous operating temperature is 200° F (93° C), intermittent 220° F (104° C).
Listed UL 900 by Underwriters Laboratories.

Options:
Available with header for side-access or front access applications, as shown at right. See Product Sheet 1303PH.

Specifications

1.0 General

1.1 · Air filters shall be high-efficiency ASHRAE high lofted supported media disposable type assembled in a compact and secure enclosing frame.

1.2 · Sizes shall be as noted on drawings or other supporting materials.

2.0 Construction

2.1 · Filter media shall be of microfine glass laminated to a reinforced backing to form a uniform lofted media blanket.

2.2 · The media blanket shall be formed into uniform tapered radial pleats and bonded to a stiffened backing that is bonded to the downstream side of the media to preclude media oscillation.

2.3 · The media shall be mechanically and chemically bonded within the frame to prevent air bypass.

2.4 · The enclosing frame shall be constructed of corrosion resistant galvanized steel. The media pleat configuration shall be maintained by bridge style plastic contour stabilizers. There shall be a minimum of four contour stabilizers on the air entering side and four on the air exiting side.

3.0 Performance

3.1 · The filter shall have a Minimum Efficiency Reporting Value of (MERV 9, MERV 11, MERV 13, MERV 14) per ASHRAE Standard 52.2. It shall have a MERV-A of (9, 11, 13, 14)* when tested under Appendix J of that standard.

3.2 · Initial resistance to airflow shall not exceed (0.20", 0.35", 0.50", 0.65")* w.g. at an airflow of 500 fpm for filters having a nominal depth of 12". For a 6" model initial resistance to airflow shall not exceed (0.08", 0.25", 0.50", 0.60")* w.g. at an airflow of 300 fpm.

3.3 · The filter shall be capable of withstanding 10" w.g. without failure of the media pack.

3.4 · Manufacturer shall provide evidence of facility certification to ISO 9001:2000.

3.5 · Filter shall be listed UL 900 by Underwriters Laboratories.

Supporting Data · Provide product test reports for each listed efficiency including all details as prescribed in ASHRAE Standard 52.2-2007 including Appendix J.

Product shall be Camfil Farr Riga-Flo or approved equal.

* Items in parentheses ( ) require selection.

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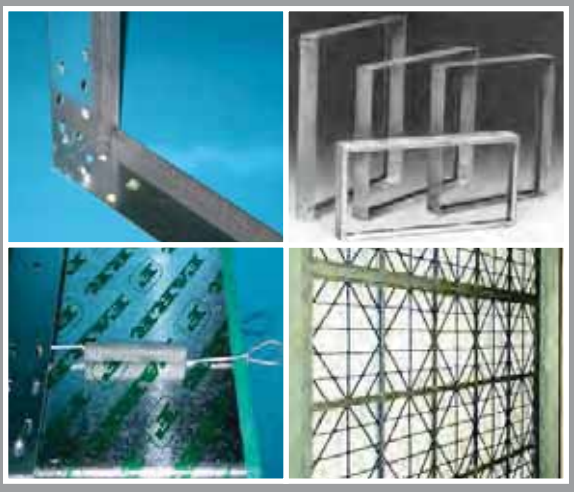
For detailed specifications please consult your local Camfil Farr Distributor or Representative or www.camfilfarr.com.
Camfil Farr has a policy of uninterrupted research, development and product improvement. We reserve the right to change designs and specifications without notice.

Camfil Farr | 1 North Corporate Drive, Riverdale, NJ 07457 | Tel: (973) 616-7300

Type 8 Frame

ASHRAE Filter Holding Frame for Built-Up Bank

A universal holding frame for air filters appled in HVAC built-up banks.



Top Left: Type 8 corner showing centering dimples, lances, welded construction and filter sealing gasket
Top Right: Available in various sizes and in stainless steel
Bottom Left: C-80 fastener and rigid filter installed, applying 25 pounds of filter sealing pressure
Bottom Right: Built-up bank, may be assembled to 6 units high

The Camfil Farr Type 8 filter holding frame, with a variety of fasteners, will allow the installation of various combinations of ASHRAE prefiltration and final filtration. The installation may include any, or combinations of the following:

- Any 1” deep panel or pleated filter
- Any 2” deep panel or pleated filter
- Any 4” deep panel or pleated filter
- Any 6” or 12” deep rigid filter
- Any headered style rigid or pocket filter

The Camfil Farr Type 8 holding frame includes:

- 16-gauge welded galvanized steel construction.
- A 3/4” filter sealing flange to assure proper filter seating and sealing.
- Filter centering dimples for ease of installation and to assure proper filter to gasket alignment.
- Polyurethane gasketing on the frame to filter sealing surface to assure leak free performance in the most demanding of applications.
- Pre-drilled holes for riveting or bolt-together installation of built-up banks.
- Multiple lances for the application of various fasteners to install a wide variety of standard size air filter.

The Camfil Farr Type 8 holding frame:

- May be assembled in banks up to six units high and any number of units wide (flat stock vertical stiffener bars are required for banks 4 to 6 units high alternating every other filter frame).
- May be applied in applications to remove water or oil mist.
- May be assembled in a V-bank configuration to reduce filter face velocity.

Type 8 Frame

ASHRAE Filter Holding Frame for Built-Up Bank

Performance Data

Part Number	Actual Depth (inches)	Actual Dimensions (inches)		Weight (lbs)
		Height	Width	
Standard Built-up Bank Application				
079473-004	2.69	24	12	4.3
079473-006		20	16	4.4
079473-005		25	16	5.0
079473-002		20	20	4.9
079473-003		25	20	5.5
079473-007		24	20	5.4
079473-001		24	24	6.0
Frames for HP Basket Assembly Applications				
050028-001	2.69	24	24	6.0
050028-004		24	12	4.3

Available options:

Available with or without gasket (standard units include gasket).

Available in 20-gauge stainless steel, 304, 304L, 316, 316L and 430.

For fasteners please consult Camfil Farr Bulletin 2902-0302.

DATA NOTES:
Flat-stock stiffener bars are required for every other vertical row on filter banks 4 to 6 units high. Stiffener bars, screws, nuts, and rivets are not supplied by Camfil Farr. Consult drawing B-073617.
For V-bank assembly consult drawing C-093248.
For mist removal installation consult drawing C-067125.

Specification

1.0 General

1.1 - Air filter holding frames shall be 16-gauge galvanized steel with filter sealing flange, centering dimples, sealing gasket and lances for appropriate air filter fasteners.

1.2 - Sizes shall be noted on drawings or other supporting materials.

2.0 Construction

2.1 - Filter holding frame shall be constructed of 16-gauge galvanized steel. The frame shall be assembled from two corner sections and welded to assure a rigid and durable frame assembly.

2.2 - The frame shall include a variety of pre-punched lances for filter fastener attachment. Fastener shall be capable of being installed without the use of tools, nuts or bolts. Lance penetrations shall be upstream of filter flange to assure leak-free integrity.

2.3 - The frame shall include filter centering dimples on each frame wall to facilitate ease of filter installation and assure filter centering against filter sealing flange.

2.4 - A 3/4" filter sealing flange shall be an integral component of the holding frame. All corners shall be flush mitered and a permanently mounted polyurethane foam gasket shall be mounted on the sealing flange to assure filter to frame sealing integrity.

3.0 Performance

3.2 - Manufacturer shall provide evidence of facility certification to ISO 9001:2008.

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For detailed specifications please consult your local Camfil Farr Distributor or Representative or www.camfilfarr.com.
Camfil Farr has a policy of uninterrupted research, development and product improvement. We reserve the right to change designs and specifications without notice.

Camfil Farr | 1 North Corporate Drive, Riverdale, NJ 07457 | Tel: (973) 616-7300

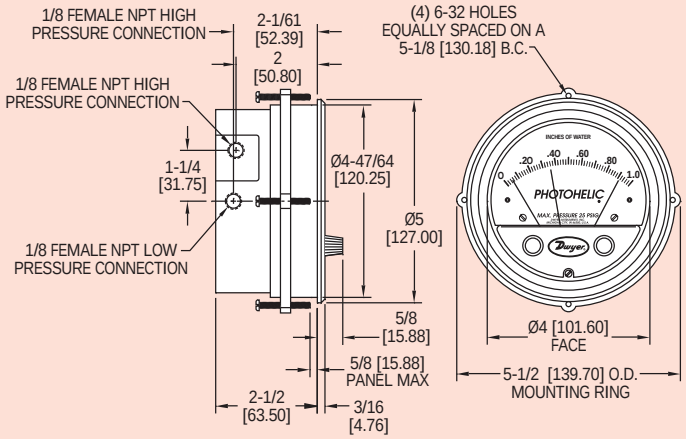
Dwyer®

Series 3000MR 3000MRS

Photohelic® Switch/Gages

Combines Differential Pressure Gage with Low/High Set-points

CE



Using solid state technology, the Series 3000MR and 3000MRS Photohelic® switch/gages combine the functions of a precise, highly repeatable differential pressure switch with a large easy-to-read analog pressure gage employing the durable, time-proven Magnehelic® gage design. Switch setting is easy to adjust with large external knobs on the gage face. Gage reading is unaffected by switch operation – will indicate accurately even if power is interrupted. Solid state design now results in greatly reduced size and weight. Units can be flush mounted in 4-13/16″ (122 mm) hole or surface mounted with hardware supplied. 3000MR models employ versatile electromechanical relays with gold over silver contacts – ideal for dry circuits. For applications requiring high cycle rates, choose 3000MRS models with SPST (N.O.) solid state relays. All models provide both low and high limit control and include 18-inch (45 cm) cable assemblies for electrical connections.

Gage accuracy is ±2% of full scale and switch repeatability is ±1%. Switch deadband is one pointer width – less than 1% of full scale. Compatible with air and other non-combustible, non-corrosive gases, they can be used in systems with pressures to 25 psig (1.725 bar). Optional construction is available for use to either 35 psig (2.42 bar) or 80 psig (5.51 bar).

Included Accessories

Mounting ring, snap ring
18" (45 cm) cable assembly
(2) ⅜" tubing to ⅛" NPT adapters
(2) ⅛" NPT pipe plugs
(4) 6-32 x 1¼" RH machine screws (panel mounting)
(3) 6-32 x ⅜" RH machine screws (surface mounting)

SPECIFICATIONS

GAGE SPECIFICATIONS

Service: Air and non-combustible, compatible gases.
Wetted Materials: Consult factory.
Accuracy: ±2% of full scale (3000-0 ±3% of full scale). (3000-00 ±4% of full scale).
Pressure Limit: -20″ Hg. to 25 psig (-0.677 bar to 1.72 bar). MP option; 35 psig (2.41 bar), HP option; 80 psig (5.52 bar).
Temperature Limits: 20 to 120°F. (-6.67 to 48.9°C).
Process Connections: 1/8″ female NPT (duplicated side and back).
Size: 4″ (101.6 mm) dial face, 5″ (127 mm) O.D. x 3-1/8″ (79.38 mm).
Weight: 1.8 lb (816 g).

SWITCH SPECIFICATIONS 3000MR

Switch Type: Each setpoint has 1 Form C relays (SPDT).
Relay Contacts: (resistive load) 1 Form C rated 1.0A @ 30 VDC, 0.3A @ 110 VDC or 0.5A @ 125 VAC. Gold over clad silver - suitable for dry circuits.
Electrical Connections: 18″ (46 cm) cable assembly with 8 conductors. Optional lengths to 100′ (30.5 m).
Power Requirements: 24 VDC, regulated ±10%.
Mounting Orientation: Diaphragm in vertical position. Consult factory for other position orientations.
Set Point Adjustment: Adjustable knobs on face.
Agency Approvals: CE.

SWITCH SPECIFICATIONS 3000MRS

Switch Type: Each setpoint has a solid state relay.
Switching Voltage: 20-280 VAC (47 - 63 Hz).
Switching Current: 1.0 amp (AC) max., 0.01 mA (AC) min., (2) SPST N.O.
Electrical Connections: 18″ (46 cm) cable assembly with 6 conductors, Optional lengths to 100′ (30.5 m).
Power Requirements: 24 VDC, regulated ±10%.
Mounting Orientation: Diaphragm in vertical position. Consult factory for other position orientations.
Set Point Adjustment: Adjustable knobs on face.
Agency Approvals: CE.

SERIES 3000MR, 3000MRS PHOTOHELIC®

Model Number	Range, Inches w.c.	Minor Divs.
3000(MR)(MRS)**-00	0-0.25	.005
3000(MR)(MRS)*-0	0-0.5	.01
3001(MR)(MRS)	0-1.0	.02
3002(MR)(MRS)	0-2.0	.05
3003(MR)(MRS)	0-3.0	.10
3005(MR)(MRS)	0-5.0	.10
3010(MR)(MRS)	0-10	.20
3015(MR)(MRS)	0-15	.50
3020(MR)(MRS)	0-20	.50
3030(MR)(MRS)	0-30	1.0
3050(MR)(MRS)	0-50	1.0
3100(MR)(MRS)	0-100	2.0

Model Number	Range, Pascals	Minor Divs.
3000(MR)(MRS)-60PA*	0-60	2.0
3000(MR)(MRS)-125PA	0-125	5.0
3000(MR)(MRS)-250PA	0-250	5.0
3000(MR)(MRS)-500PA	0-500	10.0

Model Number	Range, Kilopascals	Minor Divs.
3000(MR)(MRS)-1KPA	0-1.0	.02
3000(MR)(MRS)-3KPA	0-3.0	.10
3000(MR)(MRS)-4KPA	0-4.0	.10

Model Number	Range, MM W.C.	Minor Divs.
3000(MR)(MRS)-6MM*	0-6	.20
3000(MR)(MRS)-10MM	0-10	.50
3000(MR)(MRS)-25MM	0-25	.50
3000(MR)(MRS)-50MM	0-50	1.0
3000(MR)(MRS)-100MM	0-100	2.0

Model Number	Range, CM W.C.	Minor Divs
3000(MR)(MRS)-20CM	0-20	.50

When ordering, select either MR or MRS suffix to Series 3000 number.
Examples: 3001MR or 3001MRS

* ±3% of full scale. **± 4% of full scale.

OPTIONS — ACCESSORIES

Tamper-proof Knobs, require spanner type key (supplied) to change set-points. Add suffix **-TAMP**
Low Temperature Option for use under 20°F (-6.7°C). Add suffix **-LT**
Medium Pressure increases maximum rated pressure to 35 psig (2.41 bar). Add suffix **-MP**
High Pressure increases maximum rated pressure to 80 psig (5.5 bar). Add suffix **-HP**
A-298 Flat Aluminum Bracket, for flush mounting 3000MR/MRS

A-370 Mounting Bracket, flush mount 3000MR/MRS bracket. Bracket is then surface mounted.Steel with gray hammertone epoxy finish
A-600 R/C Snubber: Recommended for inductive loads like a solenoid or contactor

6
Mixing

RUSKIN®

AMCA LICENSED
See Page 2

3900 Dr. Greaves Rd. • Kansas City, MO 64030 • (816) 761-7476 • FAX (816) 765-8955

CD60 LOW LEAKAGE CONTROL DAMPER

High Performance Airfoil
Class 1A Leakage Rated

APPLICATION

The CD60 is a low leak, galvanized steel damper designed with airfoil blades for higher velocity and pressure HVAC systems. It meets the leakage requirements of the International Energy Conservation Code by leaking less than 3 cfm/sq. ft. at 1" of static pressure and is AMCA licensed as a Class 1A damper.

STANDARD CONSTRUCTION

FRAME
5" x 1" x 16 gage (127 x 25 x 1.6) galvanized steel hat channel reinforced with corner braces for structural strength equal to 11 gage (3.05) channel frames. Low profile 3 1/2" x 3/8" x 16 gage (89 x 10 x 1.6) galvanized steel channel top and bottom frame on dampers under 12" (305) high.

BLADES
Galvanized steel airfoil shaped, double skin construction of 14 gage (2.0) equivalent thickness, 6" (152) wide. Parallel or opposed action.

SEALS
Ruskiprene blade edge seals and flexible metal compressible jamb seals.

BEARINGS
Stainless steel sleeve.

LINKAGE
Concealed in frame.

AXLES
1/2" (13) plated steel hex. Removable control shaft extends 6" (152) beyond frame.

MAXIMUM SIZE
Single section – 60"w x 72"h (1524 x 1829).
Multiple section assembly – Unlimited size.

MINIMUM SIZE
Single blade – 8"w x 6"h (203 x 152).
Two blades, parallel or opposed action: 8"w x 10"h (203 x 254).

TEMPERATURE LIMITS
-72°F (-60°C) minimum and +275°F (+135°C) maximum.

FEATURES

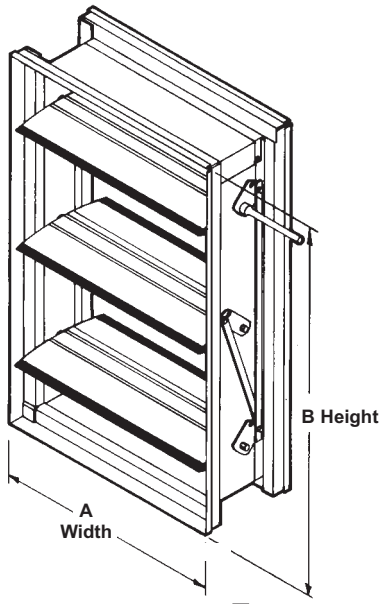
- Airfoil blade design for low pressure drop and less noise generation.
- One piece interlocking frame design to reduce racking.
- Positive lock axles, noncorrosive bearings and shake proof linkage for low maintenance operation.
- Blade edge seals mechanically lock into the blade for superior sealing.

OPTIONS

- Factory-installed, pneumatic and electric actuators.
- Enamel and epoxy finishes.
- SP100 Switch Package to remotely indicate damper blade position.
- Heavier frame construction with U-channel frame.
- Front, rear or double flange frame with or without bolt holes.
- Face and bypass configurations.

NOTE: Dimensions shown in parenthesis ( ) indicate millimeters.

*Units furnished approximately 1/4" (6) smaller than given opening dimensions.



ALL STATED SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE OR OBLIGATION.
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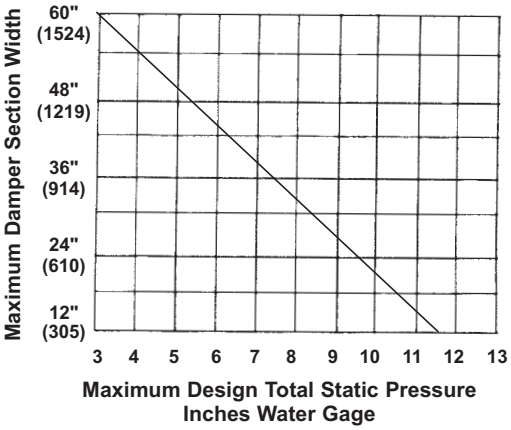
CD60 AMCA LICENSED PERFORMANCE DATA

CD60 PRESSURE LIMITATIONS



The CD60 may be used in systems with total pressures exceeding 3.5" by reducing damper section width as indicated. Example: Maximum design total pressure of 8.5" w.g. would require CD60 damper with maximum section width of 36" (914).
Pressure limitations shown above allow maximum blade deflection of 1/180 of span on 60" (1524) damper widths. Deflections in other damper widths (less than 48" [1219]) at higher pressures shown will result in blade deflection substantially less than 1/180 of span.

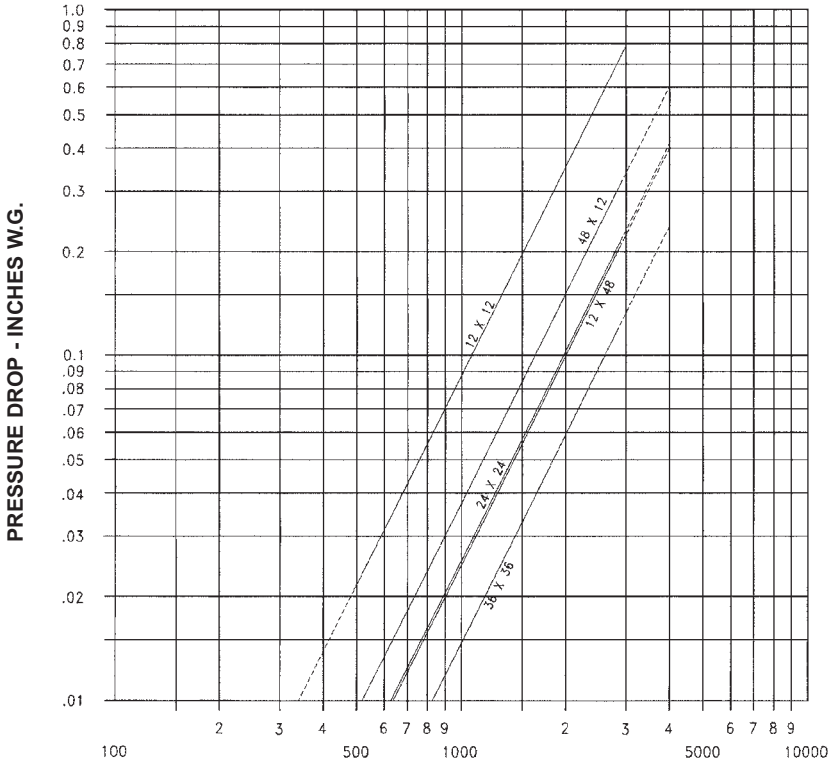
Ruskin Company certifies that the CD60 shown herein is licensed to bear the AMCA Seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 511 and comply with the requirements of the AMCA Certified Ratings Program.The AMCA International Certified Ratings Seal applies to Air Performance and Air Leakage.

Pressure/ Class	Leakage, L/s/m² (ft³/min/ft²)			
	Required Rating		Extended Ranges (Opt.)	
	1" (0.25 kPa)	4" (1.0 kPa)	8" (2.0 kPa)	12" (3.0 kPa)
1A	3 (15.2)	N/A	N/A	N/A
1	4 (20.3)	8 (40.6)	11 (55.9)	14 (71.1)
2	10 (50.8)	20 (102)	28 (142)	35 (178)
3	40 (203)	80 (406)	112 (569)	140 (711)

DAMPER WIDTH (INCHES)	1 IN. W.G.	4 IN. W.G.	8 IN. W.G.
12" (305)	IA	I	II
24" (610)	IA	I	II
36" (914)	IA	I	NA
48" (1219)	IA	I	NA
60"(1524)	IA	I	NA

Leakage testing conducted in accordance with AMCA Standard 500-D-98. Torque applied holding damper closed, 5 in. lbs./sq. ft. on opposed blade dampers and 7 in. lbs./sq. ft. on parallel blade dampers. Air leakage is based on operation between 50°F to 104°F. All data corrected to represent standard air density 0.075 lbs/ft³.

VELOCITY VS. PRESSURE DROP



FACE VELOCITY - FEET/MINUTE
AMCA FIG. 5.3

CD60 sizes 12 x 12, 24 x 24, 48 x 12, 12 x 48, 36 x 36 (305 x 305, 610 x 610, 1219 x 305, 305 x 1219, 914 x 914)

All data corrected to represent standard air at a density of 0.075 lbs/ft³.

CD60 SUGGESTED SPECIFICATION

Furnish and install, at locations shown on plans, or in accordance with schedules, control dampers that meet the following minimum construction standards. Frame shall be 16 gage (1.6) galvanized steel structural hat channel with tabbed corners for reinforcement for 11 gage (3.05) structural equivalence. Blades shall be 14 gage (2.0) equivalent thickness galvanized steel, roll-formed airfoil type for low pressure drop and low noise generation. Blade edge seals shall be Ruskiprene type or equivalent suitable for -72°F (-60°C) to +275°F (+135°C) mechanically locked into the blade edge. Adhesive or clip-on type seals are unacceptable. Jamb seals shall be flexible metal, compression type to prevent leakage between blade end and damper frame. Blade end overlapping frame is unacceptable.

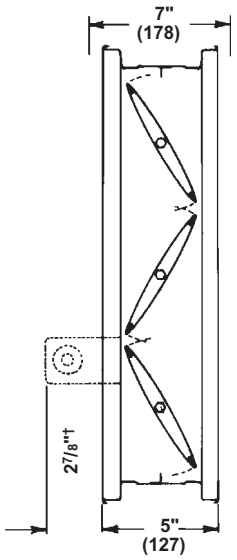
Bearings shall be corrosion resistant, permanently lubricated stainless steel sleeve type turning in an extruded hole in the damper frame. Axles shall be hexagonal positively locked into the damper blade. Linkage shall be concealed out of airstream, within the damper frame to reduce pressure drop and noise. Submittal must include leakage, maximum air flow and maximum pressure ratings based on AMCA Publication 500. Damper shall meet the leakage requirements of the International Energy Conservation Code by leaking less than 3 cfm/sq. ft. at 1" of static pressure and shall be AMCA licensed as a class 1A damper. Dampers shall be Ruskin CD60 model.

Specifier Select Options.

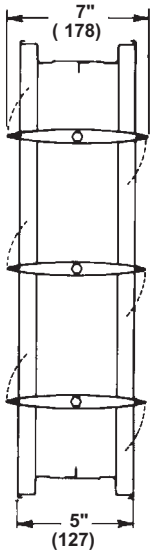
SP100: Dampers shall be equipped with factory installed damper position indication switch package. The switch package shall include two position indication switches linked directly to the damper blade to provide full open and full closed damper blade position. The switch package shall be capable of interfacing with the HVAC control system and provide remote damper blade position status. Switch package shall be Ruskin Model SP-100.

Factory Mounted Damper Actuators: If control damper actuators are required, they shall be furnished and mounted by the damper manufacturer in their factory. Each damper shall be cycle tested at the factory prior to shipment.

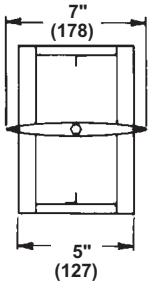
DIMENSIONAL INFORMATION



OPPOSED BLADE



PARALLEL BLADE



Low profile frame illustrated is typical for units under 12" (305) high.

440P Safety Limit Switches

30mm Metal Position Switches

The 30mm metal safety limit switches conform to EN 50041 and have been developed to provide a range of options including metal or plastic cases in various sizes, a choice of snap acting, slow break/make with 2, 3 or 4 contact configurations and a choice of actuator heads. The distance between the horizontal mounting holes is 30 mm.

The Senator range offers the option of rotating the head in 90° increments before installation to allow ease of mounting.

Allen-Bradley/Guardmaster limit switches can be used in other applications other than guard doors, for example on moving machine beds, crane arms, lifts, elevators, etc.

Operation of these limit switches is achieved by the sliding action of the guard or other moving object deflecting the plunger or lever.

ATTENTION

For safety applications it is important that upon actuation, the guard or other moving objects should not pass completely over the switch and allow the plunger or lever to return to its original position.

Specifications

Standards	EN954-1, ISO13849-1, IEC/EN60204-1, NFPA79, EN1088, ISO14119, IEC/ EN60947-5-1, ANSI B11.19, AS4024.1				
Category	Cat. 1 Device per EN954-1 Dual channel interlocks suitable for Cat. 3 or 4 systems				
Approvals	cULus, TÜV, CE and CCC Marked for all applicable directives				
Safety Contacts	1 N.C. snap acting, 2 N.C., 3 N.C. or 4 N.C. slow acting				
Auxiliary Contacts	1 N.O. (with 2 N.C.)				
Designation/Utilization Cat.					
A600/AC-15	**(Ue)**	600 V	500 V	240 V	120 V
	(Ie)	1.2 A	1.4 A	3 A	6 A
Q600/DC-13	**(Ue)**	600 V	500 V	250 V	125 V
	(Ie)	0.1 A	0.13 A	0.27 A	09.55 A
Min Current	5 V, 5 mA, DC				
Thermal Current (Ith)	8 A				
Rated Insulation Voltage	600 V AC				
Rated Impulse withstand Volt	2500 V				
Travel for Positive Opening	Various (see Product Selection table)				
Max Switching Speed	250 mm/s				
Min Switching Speed	100 mm/min				
Max Switching Frequency	6000 operation per hour				
Case Material	Die cast alloy				
Actuator Material	See Product Selection table				
Enclosure Protection	IP66				
Operating Temperature	Min -25°C (-18°F) Max 80°C (+176°F)				
Pollution Degree ❶	3				
Mechanical Life Expectancy	1 x 107				
Conduit Entry	M20 or 1/2 inch NPT				
Fixing	2 x M5				
Mounting	Any position				
Color	Red				

❶ Conductive pollution occurs, or dry, nonconductive pollution occurs which becomes conductive due to condensation.

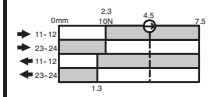
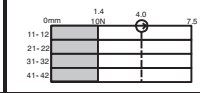
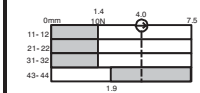
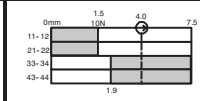
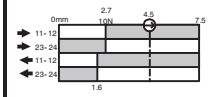
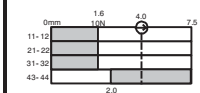
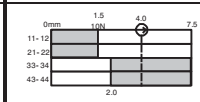
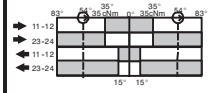
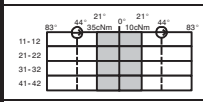
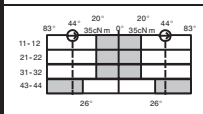
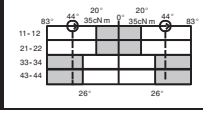
Features

- Large selection of actuator heads
- Positive operation, forced disconnection of contacts
- Snap-acting, slow make before break or slow break before make contact blocks
- Contacts 1 N.C. + 1 N.O., 2 N.C. + 1 N.O. 3 N.C., 2 N.C. + 2 N.O., 3 N.C. + 1 N.O., or 4 N.C.
- Conforms to EN 50041, EN 1088, EN 60947-5-1, EN 292 and EN 60204-1

Safety Limit Switches

Product Selection . . . . . page 5-123
Wiring . . . . . page 5-126
Dimensions . . . . . page 5-126

Product Selection

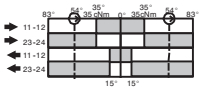
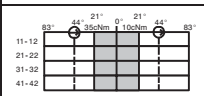
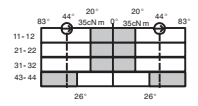
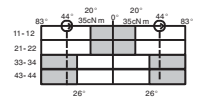
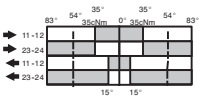
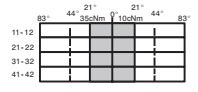
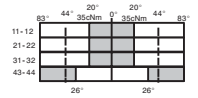
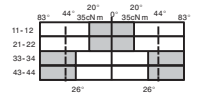
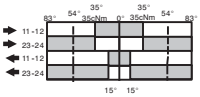
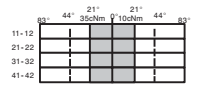
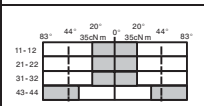
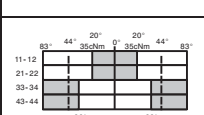
Operator Type	Contacts		Contact Type	Typical Force/ Torque to Operate	Contact Opening Characteristics □ Open ■ Closed ❸ Positive Opening Point	Cat. No.		
	Safety	Aux.				1/2 inch NPT Conduit	M20 Conduit	Quick Disconnect ❶
Metal Roller Plunger	1 N.C.	1 N.O.	Snap Acting	13 N		440P-MRPS11E	**440P-MRPS11B**	440P-MRPS11N5
	4 N.C.	—	—	11 N		440P-MRPB04E	440P-MRPB04B	440P-MRPB04M9
	3 N.C.	1 N.O.	BBM	11 N		440P-MRPB13E	440P-MRPB13B	440P-MRPB13M9
	2 N.C.	2 N.O.	BBM	11 N		**440P-MRPB22E**	440P-MRPB22B	440P-MRPB22M9
Metal Dome Plunger	1 N.C.	1 N.O.	Snap Acting	13 N		440P-MDPS11E	440P-MDPS11B	440P-MDPS11N5
	4 N.C.	—	—	11 N		440P-MDPB04E	440P-MDPB04B	440P-MDPB04M9
	3 N.C.	1 N.O.	BBM	11 N		440P-MDPB13E	440P-MDPB13B	440P-MDPB13M9
	2 N.C.	2 N.O.	BBM	11 N		440P-MDPB22E	440P-MDPB22B	440P-MDPB22M9
Metal Short Lever	1 N.C.	1 N.O.	Snap Acting	0.34 N•m		**440P-MSLS11E**	**440P-MSLS11B**	440P-MSLS11N5
	4 N.C.	—	—	0.20 N•m		440P-MSLB04E	440P-MSLB04B	440P-MSLB04M9
	3 N.C.	1 N.O.	BBM	0.34 N•m		440P-MSLB13E	440P-MSLB13B	440P-MSLB13M9
	2 N.C.	2 N.O.	BBM	0.34 N•m		440P-MSLB22E	440P-MSLB22B	440P-MSLB22M9
Recommended standard cordset, 2 m, 5-pin mini connector (see page 8-1 for additional lengths).								889N-F5AE-6F
Recommended standard cordset, 2 m, 12-pin 9 wire (see page 8-1 for additional lengths).								889M-F12X9AE-2

❶ N5 = 5-pin mini connector.
M9 = 12-pin M23 connector (use 9 wire).

440P Safety Limit Switches

30mm Metal Position Switches

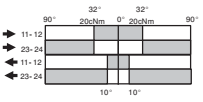
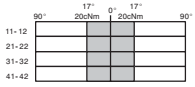
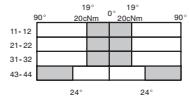
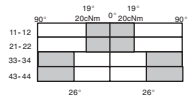
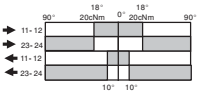
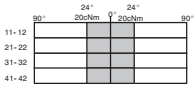
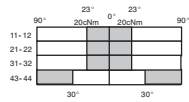
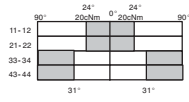
Product Selection (continued)

Operator Type	Contacts: Safety	Contacts: Aux.	Contact Type	Typical Force/ Torque to Operate	Contact Opening Characteristics (□ Open ■ Closed ◉ Positive Opening Point)	Cat. No.: 1/2 inch NPT Conduit	Cat. No.: M20 Conduit	Cat. No.: Quick Disconnect ❶
Metal Short Lever, Metal Roller	1 N.C.	1 N.O.	Snap Acting	0.34 N•m		440P-MMHS11E	440P-MMHS11B	440P-MMHS11N5
	4 N.C.	—	—	0.20 N•m		440P-MMHB04E	440P-MMHB04B	440P-MMHB04M9
	3 N.C.	1 N.O.	BBM	0.34 N•m		440P-MMHB13E	440P-MMHB13B	440P-MMHB13M9
	2 N.C.	2 N.O.	BBM	0.34 N•m		440P-MMHB22E	440P-MMHB22B	440P-MMHB22M9
Metal Adjustable Lever ❷	1 N.C.	1 N.O.	Snap Acting	0.34 N•m		**440P-MALS11E**	440P-MALS11B	440P-MALS11N5
	4 N.C.	—	—	0.20 N•m		440P-MALB04E	440P-MALB04B	440P-MALB04M9
	3 N.C.	1 N.O.	BBM	0.34 N•m		440P-MALB13E	440P-MALB13B	440P-MALB13M9
	2 N.C.	2 N.O.	BBM	0.34 N•m		**440P-MALB22E**	440P-MALB22B	440P-MALB22M9
Metal Rod Lever ❷	1 N.C.	1 N.O.	Snap Acting	0.34 N•m		440P-MARS11E	440P-MARS11B	440P-MARS11N5
	4 N.C.	—	—	0.20 N•m		440P-MARB04E	440P-MARB04B	440P-MARB04M9
	3 N.C.	1 N.O.	BBM	0.34 N•m		440P-MARB13E	440P-MARB13B	440P-MARB13M9
	2 N.C.	2 N.O.	BBM	0.34 N•m		440P-MARB22E	440P-MARB22B	440P-MARB22M9
Recommended standard cordset, 2 m, 5-pin mini connector (see page 8-1 for additional lengths).								889N-F5AE-6F
Recommended standard cordset, 2 m, 12-pin 9 wire (see page 8-1 for additional lengths).								889M-F12X9AE-2

❶ N5 = 5-pin mini connector.
M9 = 12-pin M23 connector (use 9 wire).

❷ Not positive opening

Product Selection (continued)

Operator Type	Contacts		Contact Type	Typical Force/ Torque to Operate	Contact Opening Characteristics	Cat. No.		
	Safety	Aux.			□ Open ■ Closed ❸ Positive Opening Point	1/2 inch NPT Conduit	M20 Conduit	Quick Disconnect ❶
Metal Spring Rod ❷	1 N.C.	1 N.O.	Snap Acting	0.20 N•m		440P-MSRS11E	440P-MSRS11B	440P-MSRS11N5
	4 N.C.	—	—	0.20 N•m		440P-MSRB04E	440P-MSRB04B	440P-MSRB04M9
	3 N.C.	1 N.O.	BBM	0.20 N•m		440P-MSRB13E	440P-MSRB13B	440P-MSRB13M9
	2 N.C.	2 N.O.	BBM	0.20 N•m		440P-MSRB22E	440P-MSRB22B	440P-MSRB22M9
Telescope Arm ❷	1 N.C.	1 N.O.	Snap Acting	0.20 N•m		440P-MTAS11E	440P-MTAS11B	440P-MTAS11N5
	4 N.C.	—	—	0.20 N•m		440P-MTAB04E	440P-MTAB04B	440P-MTAB04M9
	3 N.C.	1 N.O.	BBM	0.20 N•m		440P-MTAB13E	440P-MTAB13B	440P-MTAB13M9
	2 N.C.	2 N.O.	BBM	0.20 N•m		440P-MTAB22E	440P-MTAB22B	440P-MTAB22M9
Recommended standard cordset, 2 m, 5-pin mini connector (see page 8-1 for additional lengths).								889N-F5AE-6F
Recommended standard cordset, 2 m, 12-pin 9 wire (see page 8-1 for additional lengths).								889M-F12X9AE-2

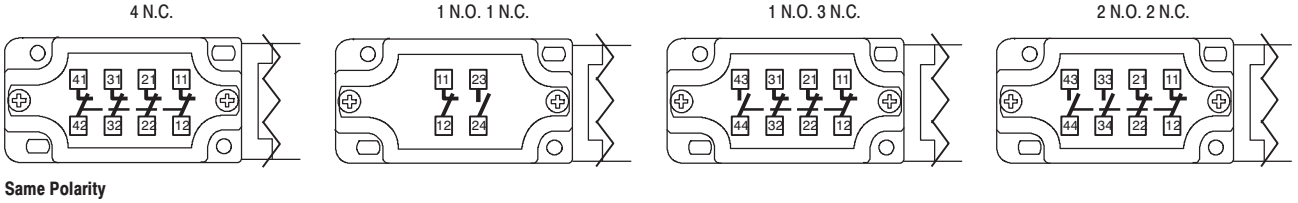
❶ N5 = 5-pin mini connector.
M9 = 12-pin M23 connector (use 9 wire).

❷ Not positive opening

440P Safety Limit Switches

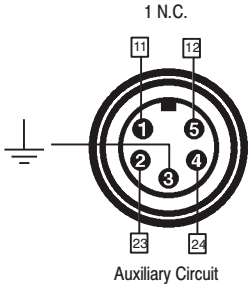
30mm Metal Position Switches

Typical Wiring Diagram

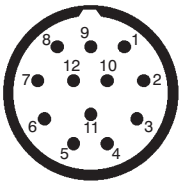


Same Polarity

N5 Connector 2 Circuit 5-Pin Mini Connector

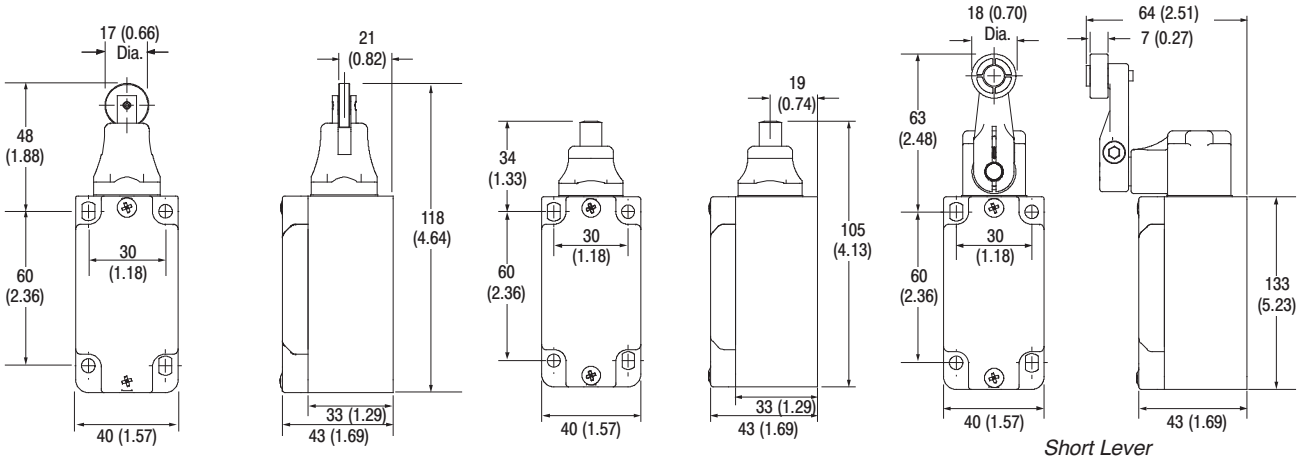


M9 12-Pin M23 Connector

Connector Pinout		4 N.C.		3 N.C. 1 N.O.		2 N.C. 2 N.O.	
		Terminal	Contact	Terminal	Contact	Terminal	Contact
	1	11	N.C.	11	N.C.	11	N.C.
	3	12		12		12	
	4	21	N.C.	21	N.C.	21	N.C.
	6	22		22		22	
	7	31	N.C.	31	N.C.	33	N.O.
	8	32		32		34	
	9	41	N.C.	43	N.O.	43	N.O.
	10	42		44		44	
	12	Ground					

Approximate Dimensions [mm (in.)]

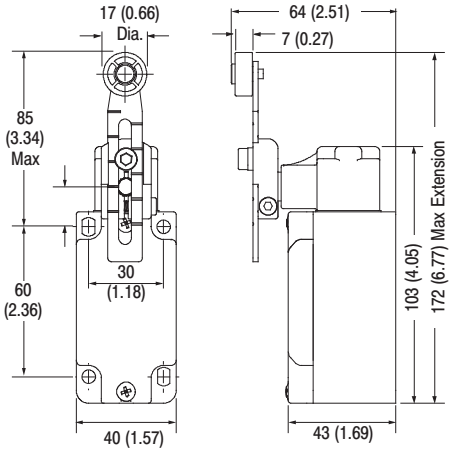
Dimensions are not intended to be used for installation purposes.



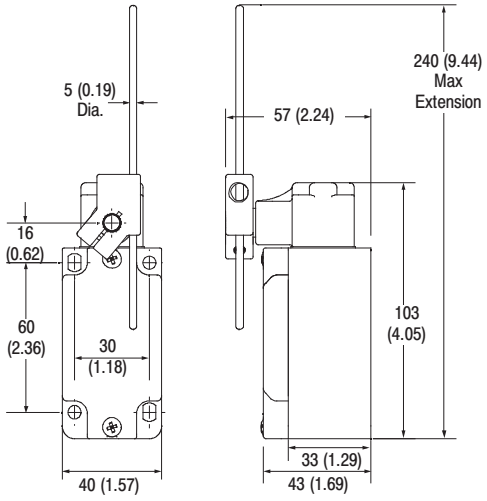
Roller Plunger *Dome Plunger* *Short Lever (Metal & Plastic Roller)*

Approximate Dimensions [mm (in.)]

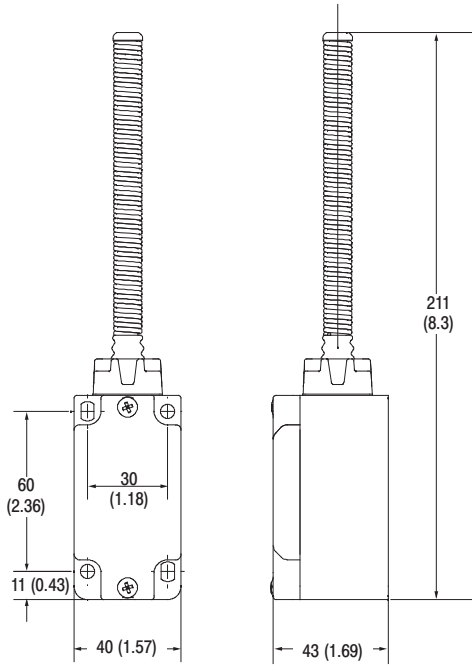
Dimensions are not intended to be used for installation purposes.



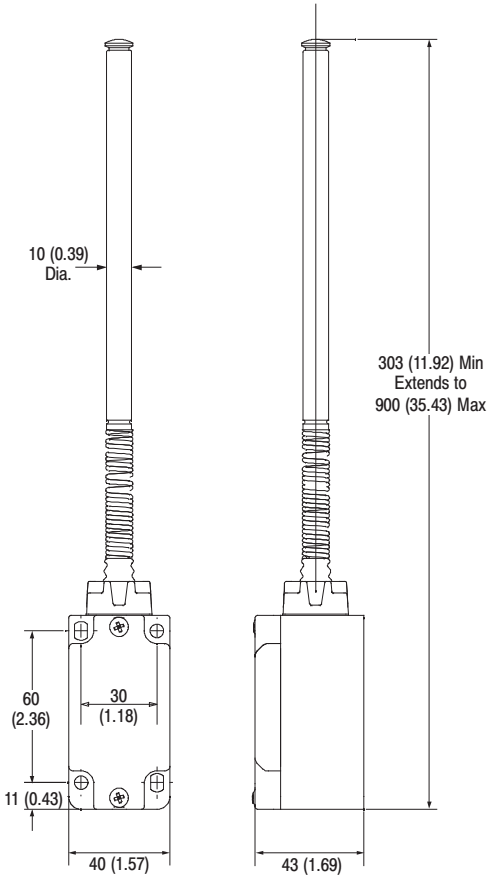
Adjustable Lever



Rod Lever



Spring Rod



Telescopic Arm

MK-3000 Series, MK2-3000 Series, MK4-3000 Series

Pneumatic Damper Actuators General Instructions

APPLICATION

Proportional pneumatic actuator with 8 in.^{2} (52 cm^2) effective area used to control dampers, mixing boxes, air valves, etc., in heating, ventilating and air conditioning systems, MK2-31X1 used for high temperatures.

SPECIFICATIONS

Construction:

Housing, Die cast aluminum.

Diaphragm, Beaded molded neoprene. *MK2-31X1 only* - Beaded molded silicone.

Stroke: See Table 2.

Start Point: Adjustable on most models ± 1 psi, see Table 2.

Spring: Retracts actuator shaft on loss of air pressure.

Maximum Air Pressure: 30 psig (207 kPa).

Ambient Temperature Limits:

Shipping, -40 to 160°F (-40 to 71°C).

Operating, -20 to 160°F (-29 to 71°C).

MK2-31X1 only,

Shipping, -40 to 250°F (-40 to 121°C).

Operating, -20 to 250°F (-29 to 121°C), for 30 minute exposure 450°F (232°C).

Air Connections: 1/8" FNPT.

Mounting: In any position. Mounting bracket (except MK-3300 Series end mounting) and connector for 5/16" (8 mm) diameter push rod included with actuator.

Dimensions: 12" high x 5-7/8" wide x 5-1/2" deep (305 mm x 143 mm x 140 mm)

ACCESSORIES

AK-42309-500	Positive positioner and linkage, do not use with MK2-3100 series
AM-111	Crank arm for 5/16" diameter damper shaft
AM-112	Crank arm for 3/8" diameter damper shaft
AM-113	Crank arm for 1/2" diameter damper shaft
AM-115	Crank arm for 7/16" diameter damper shaft
AM-122	Linkage connector straight type
AM-123	Damper clip
AM-125	5/16" x 20" damper rod
AM-125-048	5/16" x 48" damper rod
AM-132	Ball joint connector
AM-161-3	Damper linkage kit
AM-301	90° mounting bracket for pivot mounting
AM-530	Crank arm for 1/2" diameter damper shaft holes for 3-1/2" and 4-1/2" stroke
AM-532	Bolt-on frame lug and damper blade clip kit
AM-533	Actuator shaft extension
AM-534	Pivot stud for pivot mounting
AM-535	Clevis for pivot mounting
AM-536	Mounting plates for pivot mounting on ducts or damper frame
AM-545	Rod end connector for 5/16" (10 mm) dia. rods
TOOL-95	Pneumatic calibration tool kit

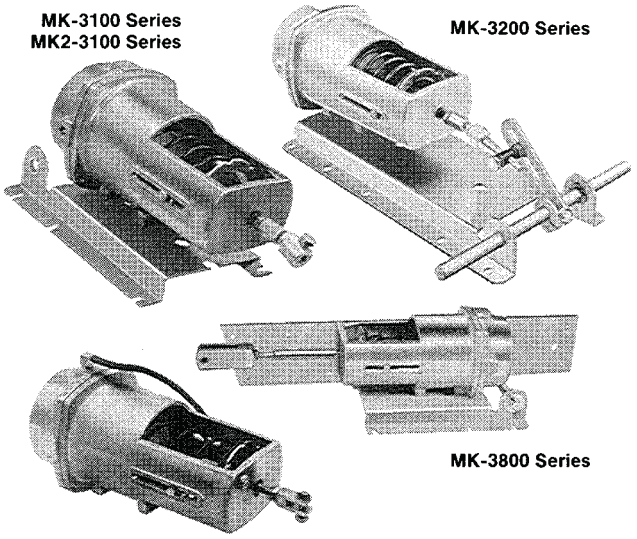


Table-1 Nominal Damper Area For Proportional Control[a]

Actuator Part Number	Parallel Blades		Opposed Blades	
	ft^2	m^2	ft^2	m^2
MK-3101 MK-3101-108 MK2-3101 MK4-3101 MK-3111 MK2-3111 MK-3121-109 MK-3121 MK2-3121 MK-3141 MK4-3141 MK-3151 MK-3161[b] MK-3201 MK-3211 MK-3221 MK-3311-109 MK-3321-102 MK-3801 MK4-3801 MK-3811 MK-3821 MK-3841 MK4-3841	11.6	1.07	15	1.39
MK4-3111[c] MK4-3811[c]	23.2	2.15	30	2.79
MK4-3121[d] MK4-3821[d]	34.8	3.23	45	4.18

[a] For two-position control use proportional rating of the same actuator with positive positioner. Damper ratings are nominal and based on standard (not low leakage) dampers at 1" (25.4 mm) W.C. static pressure and 2000 fpm (10 m/s) velocity.

[b] Requires 20 psi be available to the actuator.

[c] Requires minimum 15 psi be available to the actuator.

[d] Proportional control with positioner (8-13 spring, 20 psi supply).

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Table-2 Specifications.

Part Number	Nominal Operating Range		Starting Pressure		Nominal Stroke[a]	Maximum Force[b]								Nominal Torque[c] Proportional Control[b]					
						Return Stroke		Power Stroke											
						Based on 1.5 psi (10 kPa) Pressure to Actuator		15 psi (103 kPa) Supply Dual Press. System		15 psi (103 kPa) Supply Single Press. System[d]		20 psi (138 kPa) Supply Single or Dual Press. System		15 psi (103 kPa) Supply Dual Press. System		15 psi (103 kPa) Supply Single Press. System		20 psi (138 kPa) Supply Single or Dual Press. System[d]	
	psig	kPa	psig	kPa	in. (mm)	lb.	N	lb.	N	lb.	N	lb.	N	lb-in.	N-m	lb-in.	N-m	lb-in.	N-m
MK-3101-108	3-7.2	21-50	3 ± 1	21 ± 7	3 (76) Adjustable 2 to 4 (51 to 102)	12	53	50	226	62	276	102	454	18	2.03	18	2.03	18	2.03
MK-3101 MK2-3101	3-8	21-55	3 ± 1	21 ± 7	3 1/2 (89) Adjustable 2 to 4 (51 to 102)	12	53	44	196	56	249	96	427	21	2.37	21	2.37	21	2.37
MK4-3101[e]	3-8	21-55	3 ± 1	21 ± 7		12	53	44	196	56	249	96	427	21	2.37	21	2.37	21	2.37
MK-3111 MK2-3111	5-10	34-69	5 ± 1	3 ± 7		28	125	28	125	40	178	80	356	21	2.37	21	2.37	21	2.37
MK4-3111	5-10	34-69	5 ± 1	34 ± 7		28	125	28	125	40	178	80	356	49	5.54	49	5.54	49	5.54
MK-3121 MK-3121-109 MK2-3121[e]	8-13	55-90	8 ± 1	55 ± 7		52	231	4	18	16	71	56	249	7	79	21	2.37	21	2.37
MK4-3121[e]	8-13	55-90	8 ± 1	55 ± 7		52	231	4	18	16	71	56	249	7	79	28	3.16	91	10.28
MK-3141 MK4-3141[e]	3-13	21-90	3 non-adj	21 non-adj		12	53	4	18	16	71	56	249	7	79	21	2.37	21	2.37
MK-3151	3-6 9-12	21-41 62-83	3-6	21 to 41	2-3/4 (70) Adjustable 2 to 2-3/4 (51 to 70)	12	53	12	53	24	107	64	285	21	2.37	21	2.37	21	2.37
MK-3161	3-6 11-17	21-41 76-117	3-6	21 to 41		12	53	0	0	0	0	24	107	0	0	0	0	21	2.37
MK-3201	3-8	21-55	3 ± 1	21 ± 7	90° Rotation Typical, Adjustable 1.2 to 4.4 (30 to 111)	12	53	44	196	56	249	96	427	21	2.37	21	2.37	21	2.37
MK-3211	5-10	34-69	5 ± 1	34 ± 7		28	125	28	125	40	178	80	356	21	2.37	21	2.37	21	2.37
MK-3221	8-13	55-90	8 ± 1	55 ± 7		52	231	4	18	16	71	56	249	7	.79	21	2.37	21	2.37
MK-3311-109	5-10	34-69	5 ± 1	34 ± 7	3-1/2 (89) Adjustable 2 to 4 (51 to 102)	28	125	28	125	40	178	80	356	21	2.37	21	2.37	21	2.37
MK-3321-102	8-13	55-90	8 ± 1	55 ± 7		52	231	4	18	16	71	56	249	7	.79	21	2.37	21	2.37
MK-3801 MK4-3801[e]	3-8	21-55	3 ± 1	21 ± 7	3-1/2 (89) Adjustable 2 to 4 (51 to 102)	12	53	44	196	56	249	96	427	21	2.37	21	2.37	21	2.37
MK-3811	5-10	34-69	5 ± 1	34 ± 1		28	125	28	125	40	178	80	356	21	2.37	21	2.37	21	2.37
MK4-3811	5-10	34-69	5 ± 1	34 ± 1		28	125	28	125	40	178	80	356	49	5.54	49	5.54	49	5.54
MK-3821	8-3	55-90	8 ± 1	55 ± 1		52	231	4	18	16	71	56	249	7	79	21	2.37	21	2.37
MK4-3821[e]	8-13	55-90	8 ± 1	55 ± 1		52	231	4	18	16	71	56	249	7	79	28	3.16	91	10.28
MK-3841 MK4-3841[e]	3-13	21-90	3 non-adj	21 non-adj		12	53	4	18	16	71	56	249	7	79	21	2.37	21	2.37

[a] Factory setting required for published operating range.
[b] Force and torques based on factory set stroke and starting pressure.
[c] Nominal torque for actuators without positive positioner is based on 1.5 psi pressure change at the actuator.
[d] Adjust pressure reducing valve so that listed pressures are available at the actuator.
[e] Factory installed positive positioner (AK-42309-500) start point adjustable 2 to 10 psi with range adjustable 2 to 10 psi.

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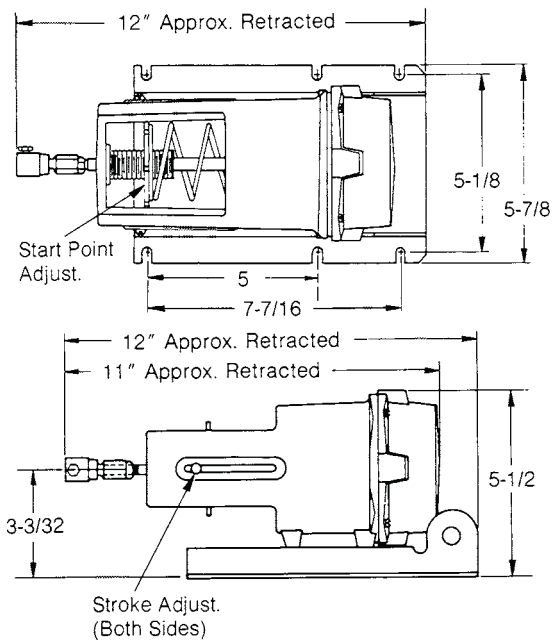


Figure-1 MK-3100 Series Dimensions.[1]

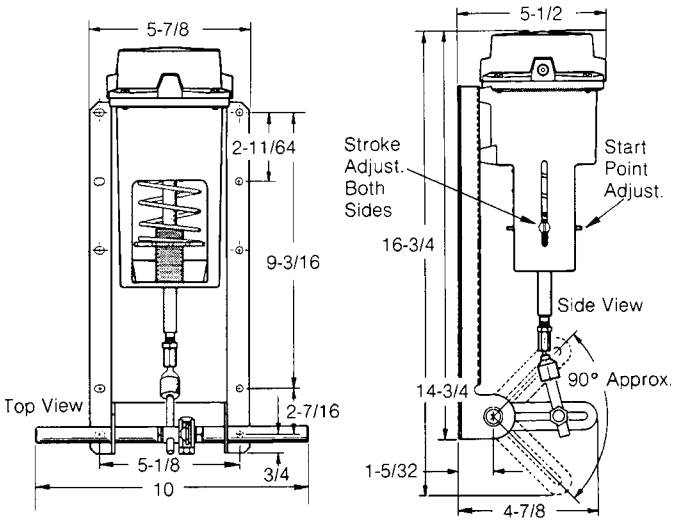
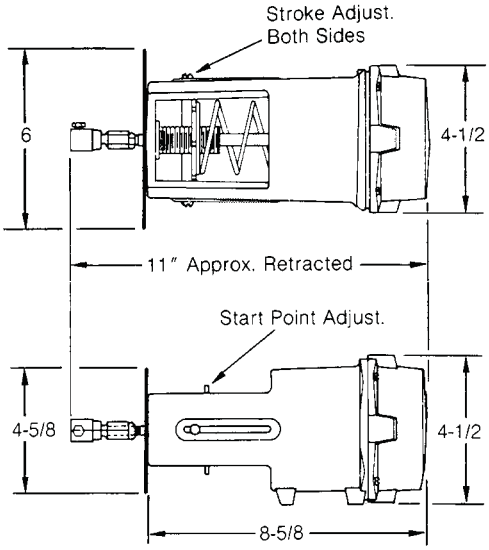
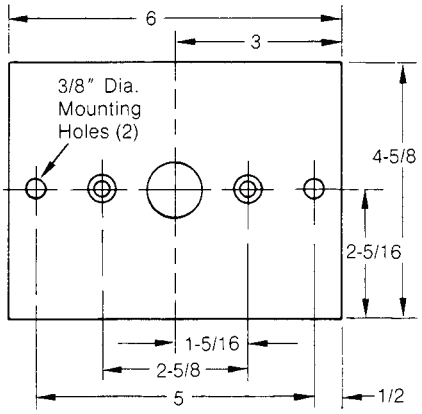


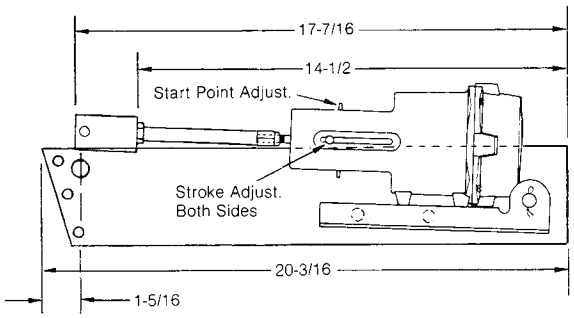
Figure-2 MK-3200 Series Dimensions.





Mounting plate for MK-3101-108 and MK-3300-102 Series Actuators

Figure-3 MK-300 Series Dimensions[2].



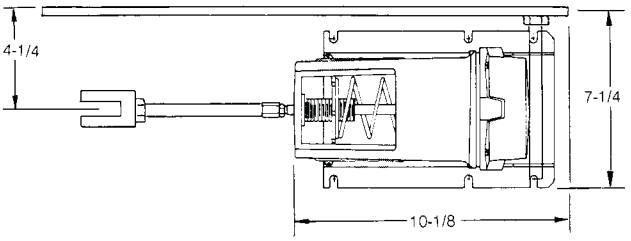


Figure-4 MK-3800 Series Dimensions.

1. All dimensions shown in the Instruction Sheet are in inches.

2. Typical Model shown. Linkage, and air connection details may vary from Model to Model.

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MK-3100 Series Typical Mounting

Accessories Required for Mounting Per Figure 5

1 — AM-113 Crank arm.

1 — AM-122-0-0-2 or AM-132-0-0-2 ball joint.

1 — AM-125 link rod 5/16-inch x 20 inches.

To mount proceed as follows. Refer to Figure 5.

1. Measure a minimum of 8 inches from damper shaft in the direction of actuator location.
2. Hold actuator up to duct with actuator shaft approximately 1-1/2 inches above (N.C.) or below (N.O.) damper shaft and mark mounting holes.
3. With drill or punch, pierce holes marked in Step 2.
4. Mount actuator to duct.
5. Attach ball joint to crank arm at approximately 2-1/2 inches from center of shaft hole.
6. Attach crank arm to damper shaft at approximately 45° angle, from vertical, toward actuator with damper in the normal actuator retracted position.
7. Connect actuator ball joint to crank arm ball joint with 5/16-inch diameter rod. Cut off excess rod.
8. Refer to Checkout.

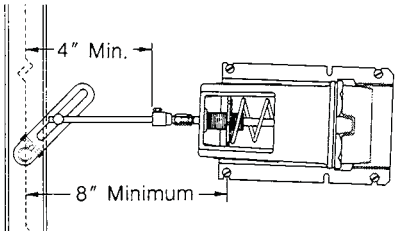

Figure-5 MK-3100 Series Typical Mounting.

MK-3300 Series Typical Mounting

Note: MK-3300 Series Models are designed for Mixing Box applications. Mounting, Linkage, and air connection details vary among Models. See Actuator Selection Sheet F-13795 for more information.

Accessories Required for Mounting Per Figure 8

1 — AM-125 link rod 5/16-inch x 20 inches.

1 — Connector as required for connection to driven device.

To mount proceed as follows. Refer to Figures 6 and 8.

1. Drill holes in mounting surface as shown in Figure 6.
2. Mount actuator.
3. Connect actuator.
4. Refer to Checkout.

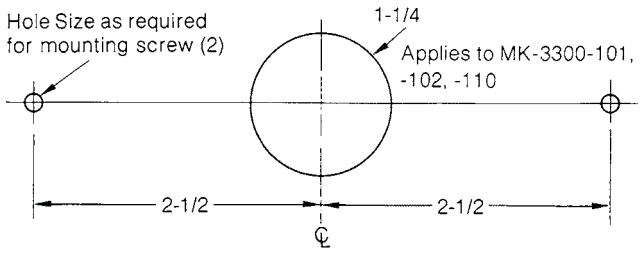

Figure-6

MK-3200 Series Typical Mounting

Accessories Required for Mounting Per Figure 7

2 — AM-113 crank arm.

2 — AM-122-0-0-2 or AM-132-0-0-2 ball joint.

1 — AM-125 link rod 5/16-inch x 20 inches.

To mount proceed as follows. Refer to Figure 7.

1. Locate actuator on a surface perpendicular to the damper shaft, with the actuator rotary shaft approximately in line with the damper shaft.
2. Hold actuator up to duct and mark mounting holes.
3. With drill or punch, pierce holes marked in Step 2.
4. Mount actuator to duct.
5. Attach crank arm to actuator shaft at approximately 45° angle.
6. Attach ball joint to crank at approximately 2-1/2 inches from center of shaft hole.
7. Attach crank arm to damper shaft an approximately 45° angle, from vertical, toward actuator with damper in the normal actuator retracted position.
8. Attach ball joint to crank arm at approximately 2-1/2 inches from center of shaft.
9. Connect actuator ball joint to crank arm ball joint with 5-1/6-inch diameter rod. Cut off excess rod.
10. Refer to Checkout.

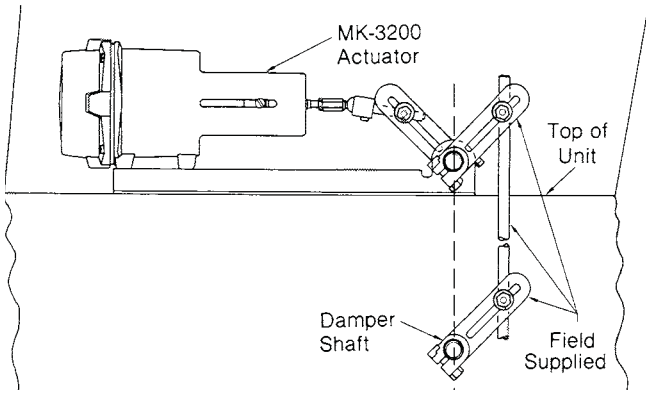

Figure-7 MK-3200 Series Typical Mounting.

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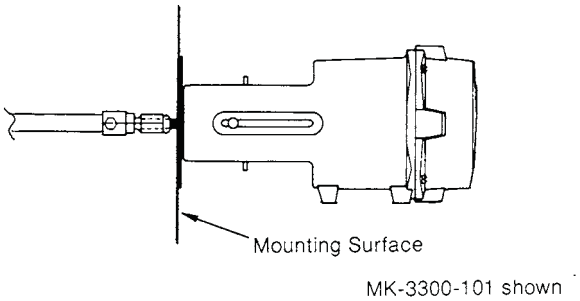

Figure-8 MK-3300 Typical Mounting.

MK-3800 Series Typical Mounting

Accessories Required for Mounting of Actuator Per Figure 9 through 11

1— AM-532 bolt-on frame bracket kit.

Note: Bracket kit includes the frame bracket, leaf connector, and necessary screws or bolts and nuts.

To install the actuator proceed as follows:

1. Prepare the damper by drilling necessary holes, etc. See Figures 11 and 15 for bolt-on bracket.
2. Attach bracket and leaf connector to damper.
3. Attach actuator mounting plate to damper bracket.
4. Install pivot stud to actuator mounting plate.
5. Install actuator to pivot stud and connect clevis to blade connector.

Note: Adjust clevis as needed to align clevis and leaf connector.

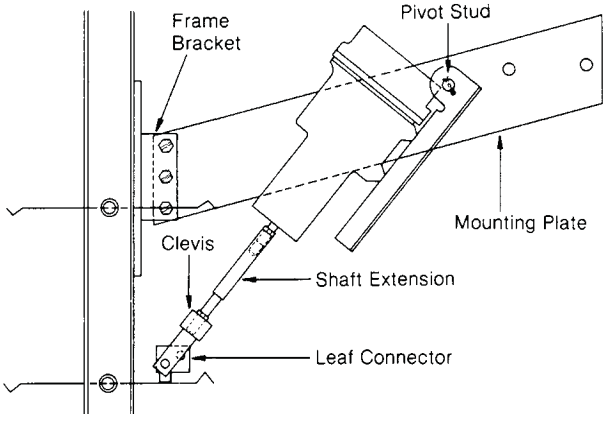

Figure-9 MK-3800 Series Typical Mounting, Normally Open.

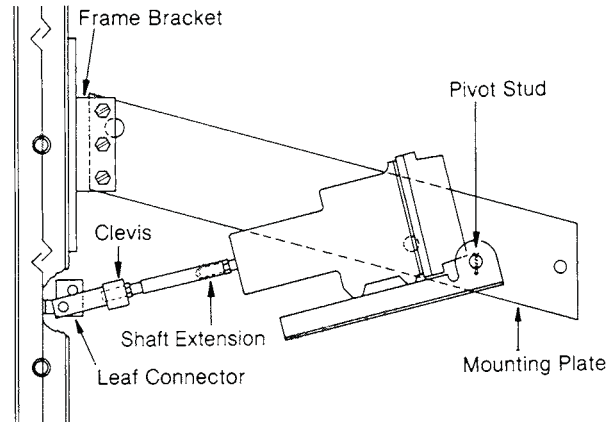

Figure-10 MK-3800 Series Typical Mounting, Normally Closed.

Preparing Damper for Frame Mounting of Actuator

Refer to Figures 11 and 15 for required holes, etc. for AM-532.

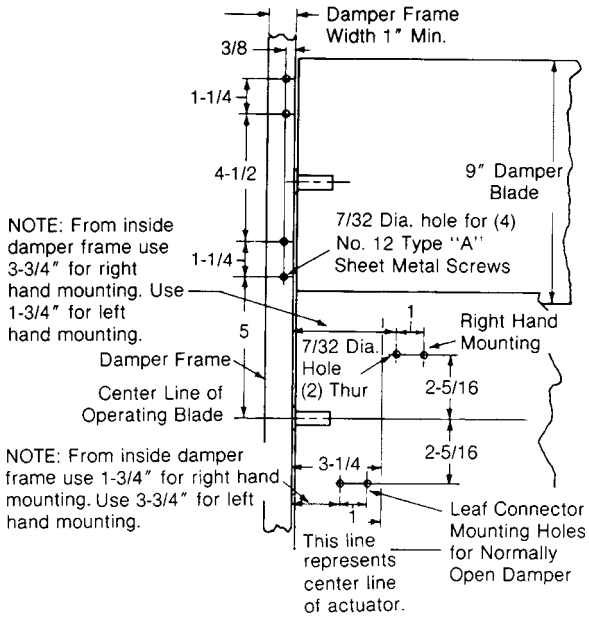
Damper Frame Width 1" Min.
3/8
1-1/4
4-1/2
9" Damper Blade
7/32 Dia. hole for (4) No. 12 Type "A" Sheet Metal Screws
NOTE: From inside damper frame use 3-3/4" for right hand mounting. Use 1-3/4" for left hand mounting.
1-1/4
5
1
Right Hand Mounting
7/32 Dia. Hole (2) Thur
Damper Frame
Center Line of Operating Blade
2-5/16
2-5/16
NOTE: From inside damper frame use 1-3/4" for right hand mounting. Use 3-3/4" for left hand mounting.
3-1/4
1
Leaf Connector Mounting Holes for Normally Open Damper
This line represents center line of actuator.

Figure-11 Typical Bolt-On Bracket Mounting.

Accessories Required for Mounting of Actuator Per Figure 12

1 — AM-530 crank arm.

To install proceed as follows:

1. Attach mounting plate to duct or wall with damper shaft protruding through locator hole in mounting plate. If this is not possible, additional shaft extensions may be used to allow locating the actuator farther from the damper shaft. Each extension provides 4 inches of extension to the actuator shaft and may be used in multiples.
2. Install the pivot stud to the mounting plate.
3. Install actuator on pivot stud.
4. Install crank arm on damper shaft at approximately 45° angle from vertical toward actuator.

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Note: Figure 12 shows position for normally closed.

5. Manually position damper to full retracted actuator position and tighten crank arm in position described in Step 4.
6. Connect clevis to crank arm in hole closest to damper shaft. If necessary adjust clevis and/or extensions.
7. Refer to Checkout.

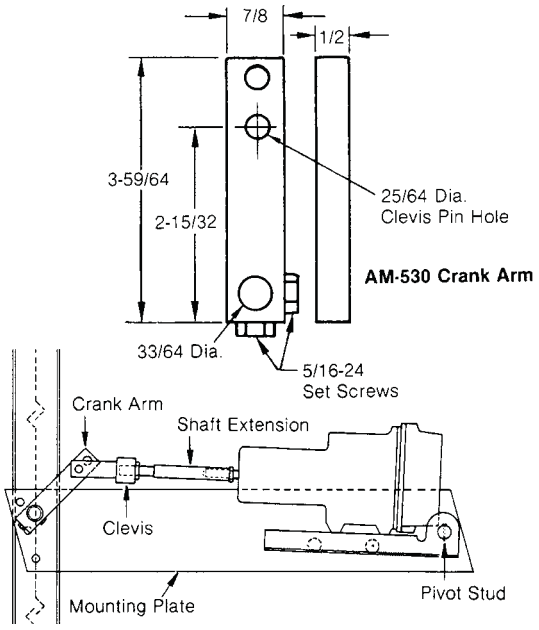

Figure-12 MK-3800 Typical External Pivot Mounted.

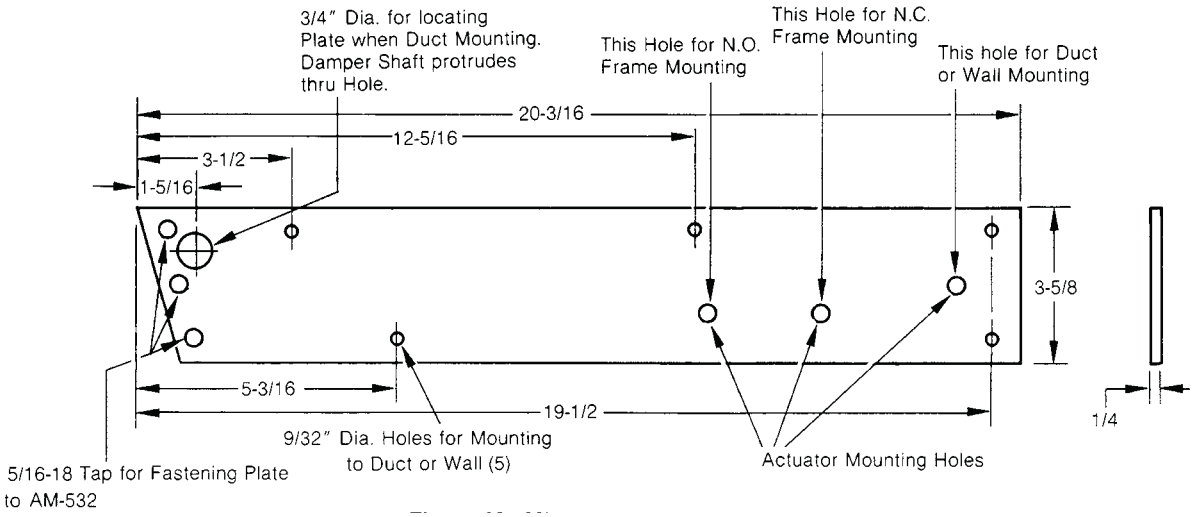

Figure-13 Mk-3800 Series Mounting Plate.

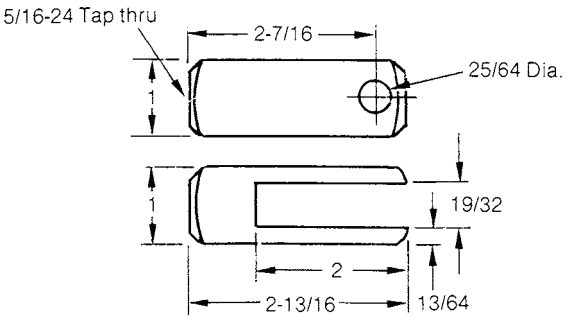

Figure-14 MK-3800 Series Clevis.

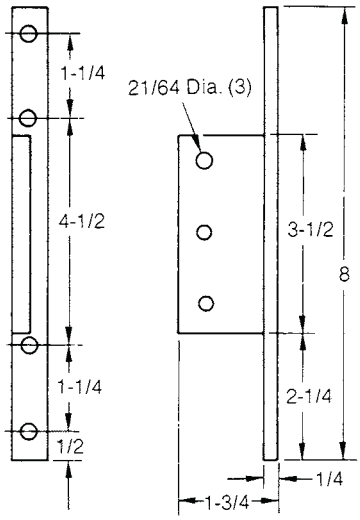

Figure-15 AM-532 Bolt-On Frame Bracket.

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CHECKOUT

After installation, the actuator should be checked to insure proper damper operation. To check the actuator and linkage, proceed as follows:

1. Check the linkage with the actuator in the retracted position for proper return force. The actuator should be linked so that on a normally closed application, the damper is closed with no more than 1/16-inch compression of the spring. (The actuator shaft would return an additional 1/16-inch if the linkage were disconnected.) For a normally open application, the actuator should be linked with the actuator fully retracted.
2. Apply air pressure to the actuator or pilot port of a positioner and check the linkage as follows. On a normally closed application, the damper should be just full open when the actuator piston reaches the stops in the actuator. On a normally open application, the damper should reach the closed position with no more than 1/16-inch stroke remaining to reach the actuator stops.
3. The above can be obtained through adjustment of the ball joint in the crank arms or by adjustment of the actuator stops. The amount of thread engagement of the actuator ball joint or extension shaft may also be used to assist in proper linking.

Connection of Air Line: On pivot mounting arrangements, Figures 9, 10 and 12, control air lines MUST be terminated at the actuator with at least 6 inches of flexible tubing to allow for pivoting of the actuator. On mounting arrangements, Figures 5, 7 and 8, control air lines may be connected directly with either copper or plastic tubing, as required by application.

Caution: On MK2-31X1 Series, metal connectors and tubing must be used.

Adjustable Starting Pressure: Actuators are available with adjustable starting pressure. To adjust the starting pressure, turn adjusting nut supporting the spring clockwise to increase and counterclockwise to decrease the starting pressure. Each rotation of the adjusting nut changes the starting pressure .04 psi (.28 kPa).

Adjustable Stroke Length: Stroke length is determined by the two stops located on either side of the actuator. Stops are set for 3-1/2-inch stroke. mark this point and measure toward the diaphragm end of the actuator to reduce the stroke or away from the diaphragm end to increase the stroke. Maximum stroke length is 4 inches. By increasing the stroke length, the force available to resist an opposing force is decreased while decreasing the stroke length increases this force.

Diaphragm Replacement: If the actuator diaphragm should leak, it may easily be replaced by removing the four screws holding the top power housing. Make sure that shaft swivel joint is in place on the end of the shaft. Remove the screws and old diaphragm. Roll the new diaphragm inside out and install over the piston making sure the circular bead is facing up. Put the top power housing back in place making sure the bead on the diaphragm is in the housing groove and the screw holes are lined up. Tighten housing screws.

UNITS WITH FACTORY MOUNTED POSITIVE POSITIONERS

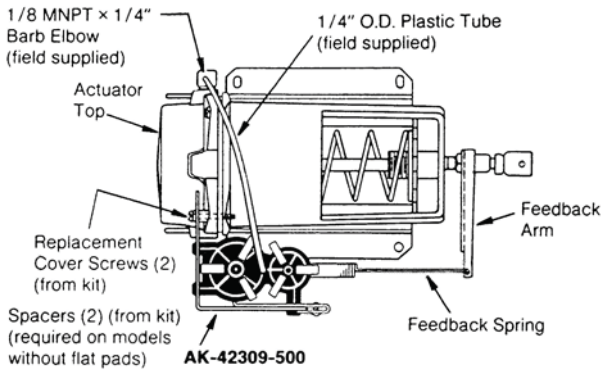
1/8 MNPT × 1/4" Barb Elbow (field supplied)
1/4" O.D. Plastic Tube (field supplied)
Actuator Top
Feedback Arm
Replacement Cover Screws (2) (from kit)
Spacers (2) (from kit) (required on models without flat pads)
Feedback Spring
AK-42309-500

Figure-16 Typical Factory Mounted Positioner.

For Actuators with Positioners:

Note: If actuator is frame pivot mounted, the actuator must be mounted to the left-hand frame. If actuator is mounted external, Figure 12 must be on right-hand side of duct.

Install fittings required in Ports 2 and 3.

ADJUSTMENTS

Refer to Figure 16.

Range Adjustment: Adjustable 2 to 10 psig (14 to 69 kPa). Factory set at 5 psig (34 kPa). Range is the pressure change required to produce full actuator stroke.

If adjustment is required (see Figure 16), with a small screwdriver loosen screw on range slider approximately 1/2 turn.

Move the graduated range slider until desired pressure mark lines up with center of screw and tighten screw.

Start Point: Adjustable 2 to 10 psig (14 to 69 kPa). Start point is the pressure at which the actuator just begins to extend. See Figure 16.

Connect main air supply to Port 3 and a variable air supply to Port 2.

1. Adjust variable air supply on Port 2 to desired start point pressure.
2. Adjust the start point screw with small screwdriver until actuator just starts to extend.
3. Gradually raise pressure on Port 2 until actuator is fully extended, and readjust range slider to obtain desired range if further adjustment is necessary.
4. Remove variable air supply from Port 2 and connect to controller output.

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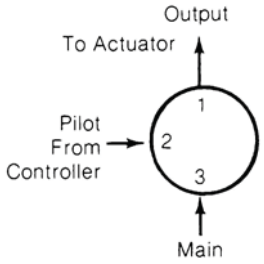

Note: If slave damper actuators are to be controlled, tee into the tubing from Port 1 to the actuators. All dampers must be mechanically interconnected.

Figure-17 Typical Piping Diagram with Factory Mounted Positive Positioner.

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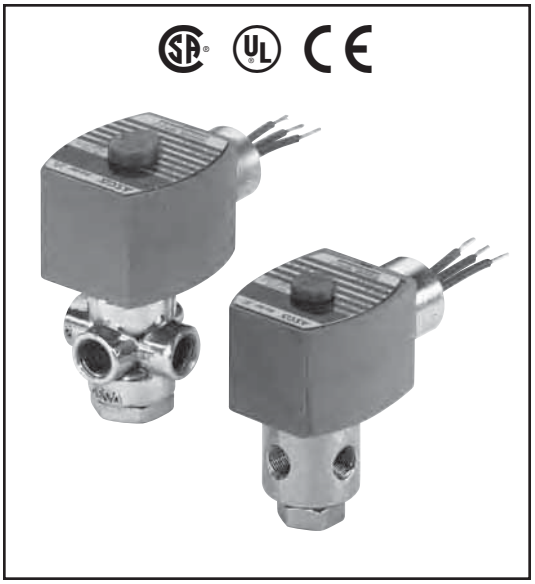
1354 Clifford Avenue
P.O. Box 2940
Loves Park, IL 61132-2940

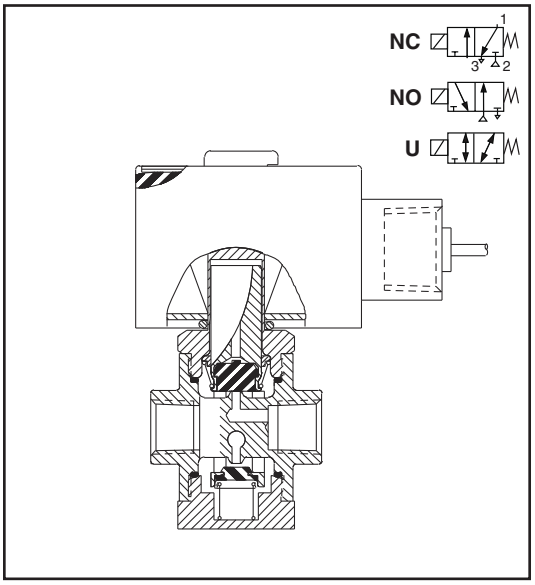
www.schneider-electric.com/buildings

F-12586-11

Features

- All NPT connections are in the valve body to allow in-line piping
- No Minimum Operating Pressure Differential required
- Broadest range of applications
- Mountable in any position





Construction

Valve Parts in Contact with Fluids		
Body	Brass	303 Stainless Steel
Seals and Disc	NBR or Cast UR, as Listed	
Core Tube	305 Stainless Steel	
Core and Plugnut	430F Stainless Steel	
Core Springs	302 Stainless Steel	
Shading Coil	Copper	Silver
Disc-Holder	CA	
Core Guide	CA (10.1 and 17.1 Watt only)	

Electrical

Standard Coil and Class of Insulation	Watt Rating and Power Consumption				Spare Coil Part Number			
		AC			General Purpose		Explosionproof	
	DC Watts	Watts	VA Holding	VA Inrush	AC	DC	AC	DC
F	10.6	6.1	16	30	238210	238310	238214	238314
F	-	9.1	25	40	238210	-	238214	-
F	11.6	10.1	25	50	238610	238710	238614	238714
F	22.6	17.1	40	70	238610	238710	238614	238714

Standard Voltages: 24, 120, 240, 480 volts AC, 60 Hz (or 110, 220 volts AC, 50 Hz). 6, 12, 24, 120, 240 volts DC. Must be specified when ordering. Other voltages are available when required.

Solenoid Enclosures

Standard: Watertight, Types 1, 2, 3, 3S, 4, and 4X.

Optional: Explosionproof and Watertight, Types 3, 3S, 4, 4X, 6, 6P, 7, and 9. (To order, add prefix "EF" to the catalog number.)

See Optional Features Section for other available options.

Nominal Ambient Temp. Ranges

AC: 32˚F to 125˚F (0˚C to 52˚C)
DC: 32˚F to 104˚F (0˚C to 40˚C)

Note: Some stainless steel constructions are rated -40˚F (-40˚C). See note ④ in specifications table.

Refer to Engineering Section for details.

Approvals

CSA certified. UL listed General Purpose Valves.
Meets applicable CE directives.

SIL 3 capable per IEC 61508 on normally closed const.
Third party certification provided by EXIDA.

Refer to Engineering Section for details.

Specifications (English units)

Pipe Size (ins.)	Orifice Size (ins.)	Cv Flow Factor	Operating Pressure Differential (psi) Max. AC Air-Inert Gas	Max. AC Water	Max. AC Lt. Oil @ 300 SSU	Max. DC Air-Inert Gas	Max. DC Water	Max. DC Lt. Oil @ 300 SSU	Max. Fluid Temp. °F AC	Max. Fluid Temp. °F DC	Brass Body Catalog Number	Brass Body Const. Ref.	Stainless Steel Body Catalog Number	Stainless Steel Body Const. Ref.	Watt Rating/ Class of Coil Insulation ② AC	Watt Rating/ Class of Coil Insulation ② DC
UNIVERSAL OPERATION (Pressure at any port)																
1/8	3/64	0.06	175	175	175	125	125	125	140	120	8320G130 ①	1	8320G140 ①	1	9.1F	10.6F
1/8	1/16	0.09	100	100	100	65	65	65	180	120	8320G001	1	8320G041 ③	1	9.1F	10.6F
1/8	1/16	0.09	175	175	175	125	125	125	200	150	8320G212	4	8320G221 ④	4	17.1/F	22.6/F
1/8	3/32	0.12	50	50	50	50	50	50	180	120	8320G083	1	8320G087 ③	1	6.1/F	10.6/F
1/8	3/32	0.12	100	100	100	60	60	60	200	150	8320G213	4	8320G222 ④	4	17.1/F	11.6/F
1/8	1/8	0.21	30	30	30	20	20	20	180	120	8320G003	1	8320G043 ③	1	9.1/F	10.6/F
1/8	1/8	0.21	50	50	50	25	25	25	200	150	8320G214	4	8320G223 ④	4	17.1/F	11.6/F
1/4	1/16	0.09	125	130	130	75	75	75	200	150	8320G172	2	-	-	10.1/F	11.6/F
1/4	1/16	0.09	175	175	175	125	125	125	200	150	-	-	8320G230 ④	3	17.1/F	22.6/F
1/4	3/32	0.12	100	100	100	60	60	60	200	150	8320G174	2	8320G200 ③④	3	17.1/F	11.6/F
1/4	1/8	0.25	50	50	50	25	25	25	200	150	8320G176	2	8320G201 ③④	3	17.1/F	11.6/F
1/4	11/64	0.35	20	20	20	12	12	12	200	150	8320G178	2	-	-	10.1/F	11.6/F
NORMALLY CLOSED (Closed when de-energized) – PFD_{AVG} = 6.81 x 10^{-4}																
1/8	3/64	0.06	200	200	200	200	200	200	180	120	8320G132	1	8320G142 ③	1	6.1F	10.6/F
1/8	1/16	0.09	150	125	125	125	125	125	180	120	8230G013	1	8320G045 ③	1	6.1F	10.6/F
1/8	1/16	0.09	210	225	225	160	160	160	200	150	8320G215	4	8320G224 ④	4	17.1/F	11.6/F
1/8	3/32	0.12	100	100	100	100	100	100	180	120	8320G015	1	8320G047 ③	1	6.1F	10.6/F
1/8	3/32	0.12	150	150	150	115	115	115	200	150	8320G216	4	8320G225 ④	4	10.1/F	11.6/F
1/8	1/8	0.21	40	40	40	40	40	40	180	120	8320G017	1	8320G049 ③	1	6.1F	10.6/F
1/8	1/8	0.21	85	85	85	60	60	60	200	150	8320G217	4	8320G226 ④	4	10.1/F	11.6/F
1/4	1/16	0.09	210	225	225	160	160	160	200	150	8320G182	2	8320G231 ④	3	17.1/F	11.6/F
1/4	3/32	0.12	150	150	150	115	115	115	200	150	8320G184	2	8320G202 ③④	3	10.1/F	11.6/F
1/4	1/8	0.25	85	85	85	60	60	60	200	150	8320G186	2	8320G203 ③④	3	10.1/F	11.6/F
1/4	11/64	0.35	45	45	45	25	25	25	200	150	8320G188	2	-	-	10.1/F	11.6/F
NORMALLY OPEN (Open when de-energized)																
1/8	3/64	0.06	200	200	200	200	200	200	180	120	8320G136	1	8320G146 ③	1	6.1F	10.6/F
1/8	1/16	0.09	150	125	125	125	125	125	180	120	8320G027	1	8320G051 ③	1	6.1F	10.6/F
1/8	1/16	0.09	235	250	250	160	160	160	200	150	8320G218	4	8320G227 ④	4	17.1/F	11.6/F
1/8	3/32	0.12	100	100	100	100	100	100	180	120	8320G029	1	8320G053 ③	1	6.1F	10.6/F
1/8	3/32	0.12	150	140	140	100	100	100	200	150	8320G219	4	8320G228 ④	4	10.1/F	11.6/F
1/8	1/8	0.21	40	40	40	40	40	40	180	120	8320G031	1	8320G055 ③	1	6.1F	10.6/F
1/8	1/8	0.21	70	70	70	55	55	55	200	150	8320G220	4	8320G229 ④	4	10.1/F	11.6/F
1/4	1/16	0.09	235	250	250	160	160	160	200	150	8320G192	2	8320G232 ④	3	17.1/F	11.6/F
1/4	3/32	0.12	150	140	140	100	100	100	200	150	8320G194	2	8320G204 ③④	3	10.1/F	11.6/F
1/4	1/8	0.25	70	70	70	55	55	55	200	150	8320G196	2	8320G205 ③④	3	10.1/F	11.6/F
1/4	11/64	0.35	40	40	40	30	30	30	200	150	8320G198	2	-	-	10.1/F	11.6/F

① Supplied with cast UR disc.
② On 50 hertz service, the watt rating for the 6.1/F solenoid is 8.1 watts; the watt rating for the 9.1/F solenoid is 11.1 watts.
③ Can be used for ***dry*** natural gas service with the EF prefix.
④ Constructions standard rated -40°F (-40°C) ambient temperature. EFX prefix and TPL # not required.

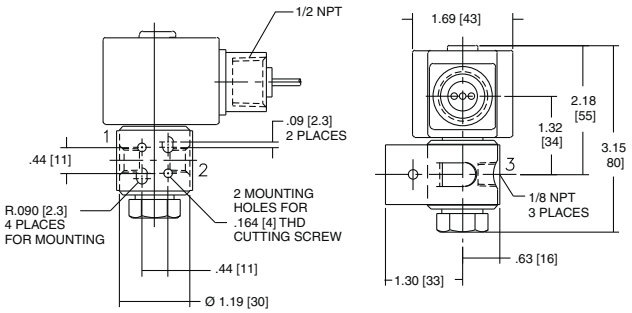
Specifications (Metric units)

Pipe Size (ins.)	Orifice Size (mm)	Kv Flow Factor (m3/h)	Operating Pressure Differential (bar) Max. AC Air-Inert Gas	Max. AC Water	Max. AC Lt. Oil @ 300 SSU	Max. DC Air-Inert Gas	Max. DC Water	Max. DC Lt. Oil @ 300 SSU	Max. Fluid Temp. °C AC	Max. Fluid Temp. °C DC	Brass Body Catalog Number	Brass Body Const. Ref.	Stainless Steel Body Catalog Number	Stainless Steel Body Const. Ref.	Watt Rating/ Class of Coil Insulation② AC	Watt Rating/ Class of Coil Insulation② DC
UNIVERSAL OPERATION (Pressure at any port)																
1/8	1.2	0.05	12	12	12	9	9	9	60	49	8320G130 ①	1	8320G140 ①	1	9.1F	10.6F
1/8	1.6	0.08	7	7	7	4	4	4	82	49	8320G001	1	8320G041 ③	1	9.1F	10.6F
1/8	1.6	0.08	12	12	12	9	9	9	93	66	8320G212	4	8320G221 ④	4	17.1/F	22.6/F
1/8	2.4	0.10	3	3	3	3	3	3	82	49	8320G083	1	8320G087 ③	1	6.1/F	10.6/F
1/8	2.4	0.10	7	7	7	4	4	4	93	66	8320G213	4	8320G222 ④	4	17.1/F	11.6/F
1/8	3.2	0.18	2	2	2	1	1	1	82	49	8320G003	1	8320G043 ③	1	9.1/F	10.6/F
1/8	3.2	0.18	3	3	3	2	2	2	93	66	8320G214	4	8320G223 ④	4	17.1/F	11.6/F
1/4	1.6	0.08	9	9	9	5	5	5	93	66	8320G172	2	-	-	10.1/F	11.6/F
1/4	1.6	0.08	12	12	12	9	9	9	93	66	-	-	8320G230 ④	3	17.1/F	22.6/F
1/4	2.4	0.10	7	7	7	4	4	4	93	66	8320G174	2	8320G200 ③④	3	17.1/F	11.6/F
1/4	3.2	0.21	3	3	3	2	2	2	93	66	8320G176	2	8320G201 ③④	3	17.1/F	11.6/F
1/4	4.4	0.30	1	1	1	1	1	1	93	66	8320G178	2	-	-	10.1/F	11.6/F
NORMALLY CLOSED (Closed when de-energized) – PFD_{AVG} = 6.81 x 10^{-4}																
1/8	1.2	0.05	14	14	14	14	14	14	82	49	8320G132	1	8320G142 ③	1	6.1F	10.6/F
1/8	1.6	0.08	10	9	9	9	9	9	82	49	8230G013	1	8320G045 ③	1	6.1F	10.6/F
1/8	1.6	0.08	14	15	15	11	11	11	93	66	8320G215	4	8320G224 ④	4	17.1/F	11.6/F
1/8	2.4	0.10	7	7	7	7	7	7	82	49	8320G015	1	8320G047 ③	1	6.1F	10.6/F
1/8	2.4	0.10	10	10	10	8	8	8	93	66	8320G216	4	8320G225 ④	4	10.1/F	11.6/F
1/8	3.2	0.18	3	3	3	3	3	3	82	49	8320G017	1	8320G049 ③	1	6.1F	10.6/F
1/8	3.2	0.18	6	6	6	4	4	4	93	66	8320G217	4	8320G226 ④	4	10.1/F	11.6/F
1/4	1.6	0.08	14	15	15	11	11	11	93	66	8320G182	2	8320G231 ④	3	17.1/F	11.6/F
1/4	2.4	0.10	10	10	10	8	8	8	93	66	8320G184	2	8320G202 ③④	3	10.1/F	11.6/F
1/4	3.2	0.21	6	6	6	4	4	4	93	66	8320G186	2	8320G203 ③④	3	10.1/F	11.6/F
1/4	4.4	0.30	3	3	3	2	2	2	93	66	8320G188	2	-	-	10.1/F	11.6/F
NORMALLY OPEN (Open when de-energized)																
1/8	1.2	0.05	14	14	14	14	14	14	82	49	8320G136	1	8320G146 ③	1	6.1F	10.6/F
1/8	1.6	0.08	10	9	9	9	9	9	82	49	8320G027	1	8320G051 ③	1	6.1F	10.6/F
1/8	1.6	0.08	16	17	17	11	11	11	93	66	8320G218	4	8320G227 ④	4	17.1/F	11.6/F
1/8	2.4	0.10	7	7	7	7	7	7	82	49	8320G029	1	8320G053 ③	1	6.1F	10.6/F
1/8	2.4	0.10	10	10	10	7	7	7	93	66	8320G219	4	8320G228 ④	4	10.1/F	11.6/F
1/8	3.2	0.18	3	3	3	3	3	3	82	49	8320G031	1	8320G055 ③	1	6.1F	10.6/F
1/8	3.2	0.18	5	5	5	4	4	4	93	66	8320G220	4	8320G229 ④	4	10.1/F	11.6/F
1/4	1.6	0.08	16	17	17	11	11	11	93	66	8320G192	2	8320G232 ④	3	17.1/F	11.6/F
1/4	2.4	0.10	10	10	10	7	7	7	93	66	8320G194	2	8320G204 ③④	3	10.1/F	11.6/F
1/4	3.2	0.21	5	5	5	4	4	4	93	66	8320G196	2	8320G205 ③④	3	10.1/F	11.6/F
1/4	4.4	0.30	3	3	3	2	2	2	93	66	8320G198	2	-	-	10.1/F	11.6/F

① Supplied with cast UR disc.
② On 50 hertz service, the watt rating for the 6.1/F solenoid is 8.1 watts; the watt rating for the 9.1/F solenoid is 11.1 watts.
③ Can be used for ***dry*** natural gas service with the EF prefix.
④ Constructions standard rated -40˚F (-40˚C) ambient temperature. EFX prefix and TPL # not required.

Dimensions: inches (mm)

Const. Ref. 1



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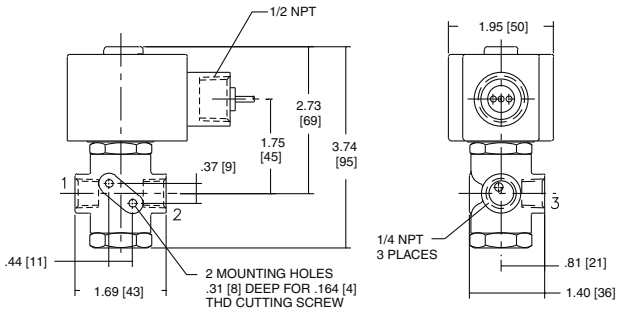

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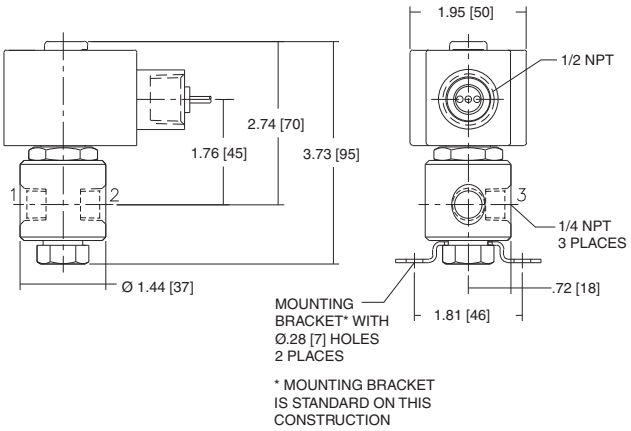
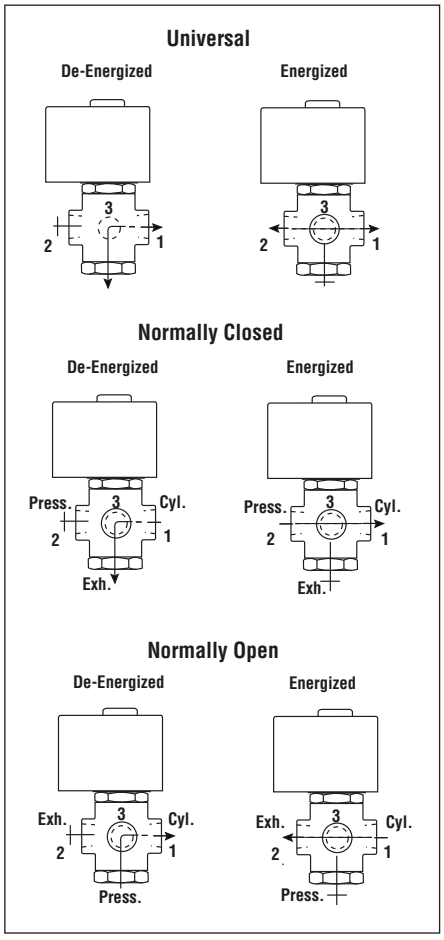


FLOW DIAGRAMS



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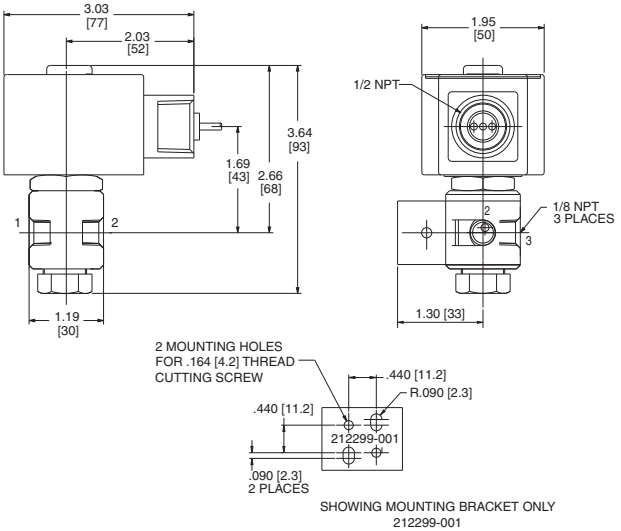


Code No. LIT-1900358
Issued May 13, 2011

M9220-xxx-3 Electric Spring Return Actuators

Description

The M9220-xxx-3 Actuators are direct mount, spring return electric actuators that operate with these available power options:

- AC 24 V at 50/60 Hz or DC 24 V (AGx, BGx, GGx, HGx)
- AC 120 V at 60 Hz (BAx)
- AC 230 V at 50/60 Hz (BDx)

These bidirectional actuators do not require a damper linkage, and are easily installed on dampers with 1/2 to 3/4 in. or 12 to 19 mm round shafts, or 3/8 and 1/2 in. or 10, 12, and 14 mm square shafts using the standard shaft clamp included with the actuator. An optional M9220-600 Jackshaft Coupler Kit is available for 3/4 to 1-1/16 in. or 19 to 27 mm round shafts, or 5/8 and 3/4 in. or 16, 18, and 19 mm square shafts.

A single M9220-xxx-3 Electric Spring Return Actuator provides a running and spring return torque of 177 lb·in (20 N·m). Two or three models mounted in tandem deliver twice or triple the torque. Integral line voltage auxiliary switches are available on the xxC models to indicate end-stop position, or to perform switching functions within the selected rotation range.

Refer to the *M9220-xxx-3 Electric Spring Return Actuators Product Bulletin (LIT-12011057)* for important product application information.

Features

- available torques of 177 lb·in (20 N·m) for single actuators, 354 lb·in (40 N·m) for two models, and 531 lb·in (60 N·m) for three models mounted in tandem — offer a selection that is most suitable for the application
- reversible mounting design — simplifies installation and enables the actuator to spring return in either direction
- electronic stall detection throughout entire rotation range — extends the life of the actuator by deactivating the actuator motor when an overload condition is detected
- removable coupler — adapts to a shorter damper shaft
- integral 48 in. (1.2 m) halogen-free cables with colored and numbered conductors — simplify field wiring
- integral auxiliary switches (xxC Models) — provide one fixed and one adjustable switch point with line voltage capability
- NEMA 2 (IP54) rated aluminum enclosure — protects the internal components of the actuator from dirt and moisture
- easy-to-use locking manual override with auto release and crank storage — allows for manual positioning of the actuator hub
- integral connectors for 3/8 in. flexible metal conduit — simplify installation and field wiring
- microprocessor-controlled brushless DC motor (-AGx, -GGx, and -HGx types) — provides constant run-time independent of torque

M9220-xxx-3 Electric Spring Return Actuator

Applications

The M9220-xxx-3 Electric Spring Return Actuators provide reliable control of dampers and valves in Heating, Ventilating, and Air Conditioning (HVAC) systems. The M9220-xxx-3 Actuators are available for use with on/off, floating, and proportional controllers.

Repair Information

If the M9220-xxx-3 Electric Spring Return Actuators fails to operate within its specifications, refer to the *M9220-xxx-3 Electric Spring Return Actuators Product Bulletin (LIT-12011057)* for a list of repair parts available.

Selection Chart

Code Number	Control Type	Auxiliary Switches	Power Requirements
M9220-AGA-3	Floating	None	AC 24 V at 50/60 Hz or DC 24 V
M9220-AGC-3	Floating	Two	AC 24 V at 50/60 Hz or DC 24 V
M9220-BAA-3	On/Off	None	AC 120 V at 60 Hz
M9220-BAC-3	On/Off	Two	AC 120 V at 60 Hz
M9220-BDA-3	On/Off	None	AC 230 V at 50/60 Hz
M9220-BDC-3	On/Off	Two	AC 230 V at 50/60 Hz
M9220-BGA-3	On/Off	None	AC 24 V at 50/60 Hz or DC 24 V
M9220-BGC-3	On/Off	Two	AC 24 V at 50/60 Hz or DC 24 V
M9220-GGA-3	Proportional	None	AC 24 V at 50/60 Hz or DC 24 V
M9220-GGC-3	Proportional	Two	AC 24 V at 50/60 Hz or DC 24 V
M9220-HGA-3	Proportional w/Adjustable Zero and Span	None	AC 24 V at 50/60 Hz or DC 24 V
M9220-HGC-3	Proportional w/Adjustable Zero and Span	Two	AC 24 V at 50/60 Hz or DC 24 V

The performance specifications are nominal and conform to acceptable industry standards. For applications at conditions beyond these specifications, consult the local Johnson Controls office. Johnson Controls, Inc. shall not be liable for damages resulting from misapplication or misuse of its products. © 2011 Johnson Controls, Inc.

M9220-xxx-3 Electric Spring Return Actuators (Continued)

Accessories

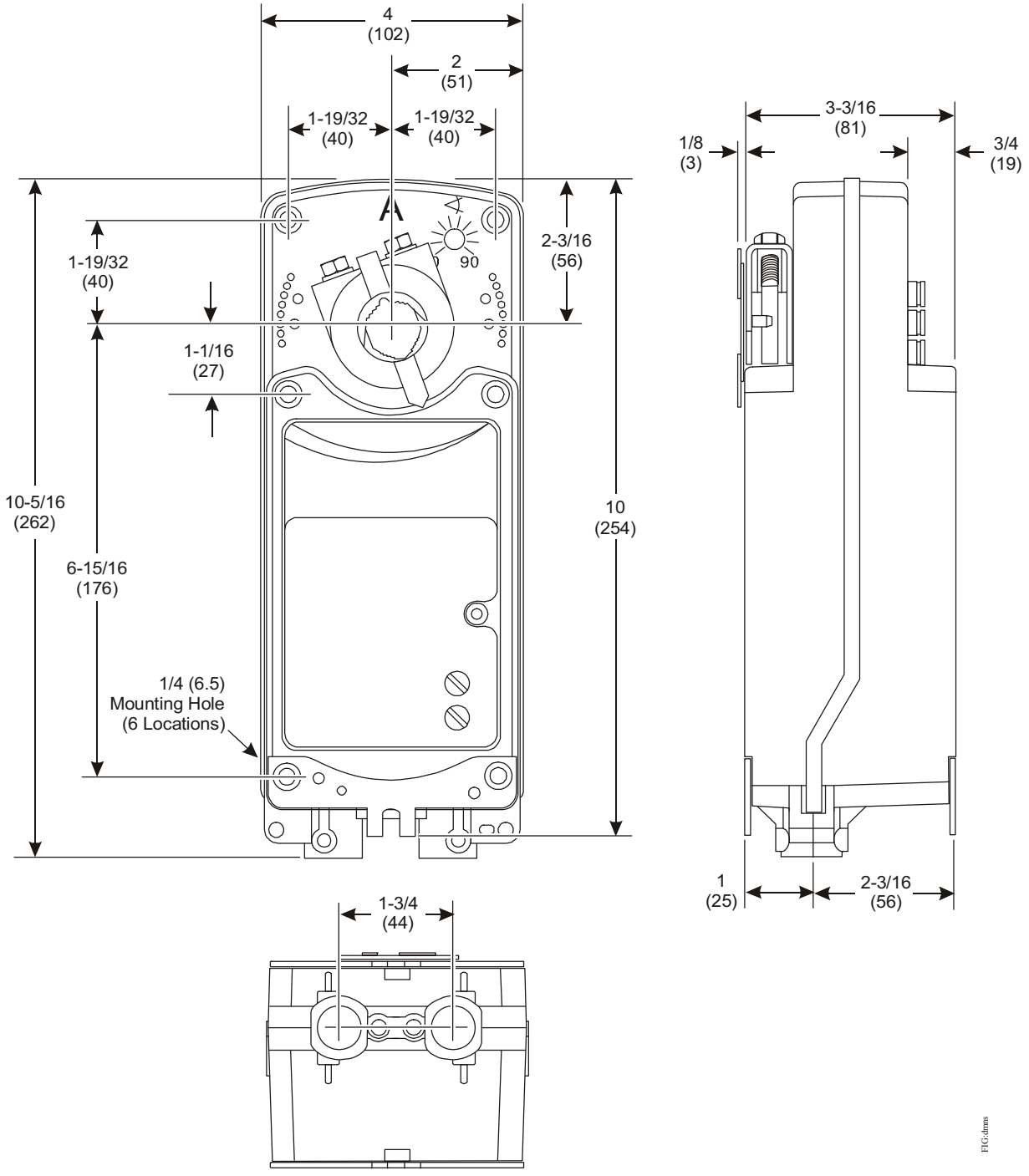
Code Number	Description
DMPR-KC003[1]	7 in. (178 mm) Blade Pin Extension (without Bracket) for Johnson Controls® Direct-Mount Damper Applications (quantity 5)
M9000-153	Crank arm (quantity 1)
M9000-158	Tandem Mounting Kit used to Mount Two Models of M9220-xxx-3 Series Proportional Electric Spring Return Actuators (quantity 1)
M9000-170	Remote Mounting Kit, Horizontal. Kit includes Mounting Bracket, M9000-153 Crank Arm, Ball Joint, and Mounting Bolts (quantity 1)
M9000-171	Remote Mounting Kit, Vertical. Kit includes Mounting Bracket, M9000-153 Crank Arm, Ball Joint, and Mounting Bolts (quantity 1)
M9000-200	Commissioning Tool that Provides a Control Signal to Drive 24 V On/Off, Floating, Proportional, and/or Resistive Electric Actuators (quantity 1)
M9000-320	Weather Shield Enclosure - NEMA 3R enclosure for protecting a single M9210/20 actuator from rain, sleet, or snow (quantity 1)
M9000-400	Jackshaft Linkage Kit. Open-ended design enables clamping onto a jackshaft without requiring access to the ends of the jackshaft (quantity 1)
M9000-604	Replacement Anti-rotation Bracket Kit (with Screws) for M9220-xxx-3 Series Proportional Electric Spring Return Actuators (quantity 1)
M9200-100	Threaded Conduit Adapter, 1/2 NPSM, for M9210(20) and M(VA)9208 Series Actuators (quantity 5)
M9220-600	1 in. (25 mm) Jackshaft Coupler Kit (with Locking Clip) for Mounting M9220-xxx-3 Proportional Electric Spring Return Actuators on Dampers with 3/4 to 1-1/16 in. or 19 to 27 mm Round Shafts, or 5/8 and 3/4 in. or 16, 18, and 19 mm Square Shafts (quantity 1)
M9220-601	Replacement Coupler Kit (with Locking Clip) for Mounting M9220-xxx-3 Proportional Electric Spring Return Actuators on Dampers with 1/2 to 3/4 in. or 12 to 19 mm Round Shafts, or 3/8 and 1/2 in. or 10, 12, and 14 mm Square Shafts (quantity 1)
M9220-602	Replacement Locking Clips for M9220-xxx-3 Proportional Electric Spring Return Actuators (Five per Bag)
M9220-603	Adjustable Stop Kit for M9220-xxx-3 Proportional Electric Spring Return Actuators (quantity 1)
M9220-604	Replacement Manual Override Cranks for M9220-xxx-3 Proportional Electric Spring Return Actuators (Five per Bag)
M9220-610	Replacement Shaft Gripper, 10 mm Square Shaft with Locking Clip (quantity 1)
M9220-612	Replacement Shaft Gripper, 12 mm Square Shaft with Locking Clip (quantity 1)
M9220-614	Replacement Shaft Gripper, 14 mm Square Shaft with Locking Clip (quantity 1)

1. Furnished with the damper and may be ordered separately.

The performance specifications are nominal and conform to acceptable industry standards. For applications at conditions beyond these specifications, consult the local Johnson Controls office. Johnson Controls, Inc. shall not be liable for damages resulting from misapplication or misuse of its products. © 2011 Johnson Controls, Inc. **www.johnsoncontrols.com**

M9220-xxx-3 Electric Spring Return Actuators (Continued)

Dimensions



M9220-xxx-3 Electric Spring Return Actuator Dimensions, in. (mm)

The performance specifications are nominal and conform to acceptable industry standards. For applications at conditions beyond these specifications, consult the local Johnson Controls office. Johnson Controls, Inc. shall not be liable for damages resulting from misapplication or misuse of its products. © 2011 Johnson Controls, Inc. **www.johnsoncontrols.com**

M9220-xxx-3 Electric Spring Return Actuators (Continued)

Technical Specifications

M9220-xxx Electric Spring Return Actuators (Part 1 of 2)		
Product Codes		M9220-AGx-3 Models: Floating M9220-Bxx-3 Models: On/Off M9220-GGx-3 Models: Proportional M9220-HGx-3 Models: Proportional Adjustable
Power Requirements	**AGx, HGx, GGx Models**	AC 24 V (19.2 to 30 V) at 50/60 Hz: Class 2, 15.5 VA Running, 7.7 VA Holding Position; DC 24 V (21.6 to 26.4 V): Class 2, 6.7 W Running, 2.9 W Holding Position
	BAx Models	AC 120 V (AC 102 to 132 V) at 60 Hz: 0.25 A Running, 0.13 A Holding Position
	BDx Models	AC 230 V (AC 198 to 264 V) at 50/60 Hz: 0.15 A Running, 0.09 A Holding Position
	BGx Models	AC 24 V (19.2 to 30 V) at 50/60 Hz: Class 2, 24.6 VA Running, 7.7 VA Holding Position; DC 24 V (21.6 to 26.4 V): Class 2, 17.6 W Running, 2.8 W Holding Position
Transformer Sizing Requirements	**AGx, HGx, GGx Models**	20 VA Minimum per Actuator
	Bxx Models	25 VA Minimum per Actuator
Input Signal/Adjustments	**AGx Models**	DC 0 (2) to 10 V or 0 (4) to 20 mA with Field Furnished 500 ohm resistor; Switch Selectable Direct or Reverse Action with Signal Increase, 500 ms minimum pulse width
	GGx Models	Factory Set DC 0 to 10 V, CW Rotation with Signal Increase; Selectable DC 0 (2) to 10 V or 0 (4) to 20 mA with Field Furnished 500 ohm, 0.25 W minimum resistor; Switch Selectable Direct or Reverse Action with Signal Increase
	HGx Models	Factory Set DC 0 to 10 V, CW Rotation with Signal Increase; Selectable DC 0 to 10 V or 0 to 20 mA with Field Furnished 500 ohm, 0.25 W minimum resistor; Start Point Programmable DC 0 to 10 V; Span Programmable DC 2 to 10 V; Switch Selectable Direct or Reverse Action with Signal Increase
Control Input Impedance	**GGx, HGx Models**	Voltage Input: 200,000 ohms; Current Input: 500 ohms with Field Furnished 500 ohm Resistor
Feedback Signal	**GGx Models**	0 (2) to 10 VDC for Desired Rotation Range up to 90°; Corresponds to Rotation Limits, 1 mA maximum
	HGx Models	0 to 10 VDC for Desired Rotation Range up to 90°; Corresponds to Rotation Limits, 1 mA maximum
Auxiliary Switch Rating	**xxC Models**	Two Single-Pole, Double-Throw (SPDT), Double-Insulated Switches with Gold Flash Contacts: AC 24 V, 50 VA Pilot Duty; AC 120 V, 5.8 A Resistive, 1/4 hp, 275 VA Pilot Duty; AC 240 V, 5.0 A Resistive, 1/4 hp, 275 VA Pilot Duty
Spring Return		Direction is Selectable with Mounting Position of Actuator: Side A, Actuator Face Away from Damper for CCW Spring Return; Side B, Actuator Face Away from Damper for CW Spring Return
Running and Spring Return Torque		177 lb·in (20 N·m) for a Single Actuator; 354 lb·in (40 N·m) for Two Models Mounted in Tandem 531 lb·in (60 N·m) for Three Models Mounted in Tandem
Valid Tandem Combinations		Two M9220-Bxx-3 Three M9220-AGx-3 One M9220-HGx-3 master with one or two M9220-GGX-3 slaves One M9220-GGx-3 master with one or two M9220-GGX-3 slaves
Rotation Range		Adjustable from 30 to 90° CW or CCW with Optional M9220-603 Adjustable Stop Kit; Mechanically Limited to 90°
Rotation Time Power On (Running)	**AGx, HGx, GGx Models**	150 Seconds for 0 to 177 lb·in (0 to 20 N·m) at All Operating Conditions; Independent of Load
	BGx Models	24 to 57 Seconds for 0 to 177 lb·in (0 to 20 N·m) at All Operating Conditions; 35 Seconds Nominal at Full Rated Load
Rotation Time Power Off (Spring Returning)	**AGx, HGx, GGx Models**	20 Seconds for 0 to 177 lb·in (0 to 20 N·m) at Room Temperature
	BGx Models	11 to 15 Seconds for 0 to 177 lb·in (0 to 20 N·m) at Room Temperature; 35 Seconds Maximum for 0 to 177 lb·in (0 to 20 N·m) at -22°F (-30°C) 130 Seconds Maximum for 0 to 177 lb·in (0 to 20 N·m) at -40°F (-40°C)
Cycles		60,000 Full Stroke Cycles; 1,500,000 repositions
Audible Noise Rating (AGx, HGx, GGx Models)	**Power On (Running)**	<40 dBA at 39-13/32 in. (1 m)
	Power On (Holding)	<20 dBA at 39-13/32 in. (1 m)
	Power Off (Spring Returning)	<55 dBA at 39-13/32 in. (1 m)

The performance specifications are nominal and conform to acceptable industry standards. For applications at conditions beyond these specifications, consult the local Johnson Controls office. Johnson Controls, Inc. shall not be liable for damages resulting from misapplication or misuse of its products. © 2011 Johnson Controls, Inc.

M9220-xxx-3 Electric Spring Return Actuators (Continued)

M9220-xxx Electric Spring Return Actuators (Part 2 of 2)		
Audible Noise Rating (BGx Models)	**Power On (Running)**	<66 dBA at 39-13/32 in. (1 m)
	Power On (Holding)	<18 dBA at 39-13/32 in. (1 m)
	Power Off (Spring Returning)	<66 dBA at 39-13/32 in. (1 m)
Electrical Connections	**Actuator (All Models)**	48 in. (1.2 m) Halogen-Free Cable with 18 AWG (0.75 mm^2) Wire Leads
	Auxiliary Switches (xxC Models)	48 in. (1.2 m) Halogen-Free Cable with 18 AWG (0.75 mm^2) Wire Leads
Conduit Connections		Integral Connectors for 3/8 in. (10 mm) Flexible Metal Conduit
Mechanical Connections	**Standard Shaft Clamp Included with Actuator**	1/2 to 3/4 in. or 12 to 19 mm Diameter Round Shafts, or 3/8 and 1/2 in. or 10, 12, and 14 mm Square Shafts
	Optional M9220-600 Jackshaft Coupler Kit	3/4 to 1-1/16 in. or 19 to 27 mm Diameter Round Shafts, or 5/8 and 3/4 in. or 16, 18, and 19 mm Square Shafts
Aluminum Enclosure		NEMA 2 (IP54) for All Mounting Orientations
Ambient Conditions	**Operating**	-40 to 131°F (-40 to 55°C); 90% RH Maximum, Noncondensing
	Storage	-85 to 185°F (-65 to 85°C); 95% RH Maximum, Noncondensing
Dimensions		See *Dimensions*.
Compliance	**United States**	UL Listed, CCN XAPX, File E27734; to UL 60730-1A: 2003-08, Ed. 3.1, Automatic Electrical Controls for Household and Similar Use; and UL 60730-2-14: 2002-02, Ed. 1, Part 2, Particular Requirements for Electric Actuators. (Models: All)
	Canada	UL Listed, CCN XAPX7, File E27734; to UL 60730-1:02-CAN/CSA: July 2002, 3rd Ed., Automatic Electrical Controls for Household and Similar Use; and CSA C22.2 No. 24-93 Temperature Indicating and Regulating Equipment (Models: All).
CE	**Europe**	CE Mark – Johnson Controls, Inc., declares that this product is in compliance with the essential requirements and other relevant provisions of the EMC Directive 2004/108/EC and Low Voltage Directive 2006/95/EC.
	Australia and New Zealand	C-Tick Mark, Australia/NZ Emissions Compliant (Models: All)
Shipping Weight	**xGx Models**	6.4 lb (2.9 kg)
	BAx and BDx Models	7.6 lb (3.5 kg)

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7
Humidifier

14949 Technology Drive, Eden Prairie, MN 55344
(800) 328-4447 Fax (952) 229-3200

PROJECT Flex 100 Lilly

ADDRESS

BUFFALO AIR HANDLING **SO#130079**

SPECIFICATION SECTION **"Humidifier"**

ARCHITECT

Thomas Engineering

CONSULTING ENGINEER

(Buffalo Air Handling)

CONTRACTOR

Engineered Air – Buffalo, NY

REPRESENTATIVE

(716) 822-4500

REPRESENTATIVE PHONE

June 12, 2013

DATE OF SUBMITTAL

Project Name: Lilly Flex 100− Thomas Engrg.
Quote Date: 12.11.2012 **Unit of Measure:** Inch−Pound
Humidifier Tag: SO#130079 AHU

System Quantity:	1	**Calculation Method:**	Mechanical	**Airflow (CFM)**	1700.00
Elevation (feet)	600.0	**Desired Dry Bulb (°F)**	68.0	**Entering Outside Air (%)**	100
Entering Dry Bulb (°F)	−4.0	**Desired RH (%)**	100	**Load (lbs/hr)**	108.96
Entering RH (%)	20	**Actual RH (%)**	100		

(All Values are per unit, unless otherwise noted)

Energy Source	Pressurized Steam
Water Type	DI/RO
Steam Pressure (psi)	15

Model	Qty.	Volts/Phase/Amp (Each)	Humidifier Outlet			Size (inches) W x H x L	Valve (Cv)	Size (inches)		
			Type	Diameter (inches)	Qty.			Valve	Strainer	Trap
STS−100S	1	120/Single/0.6	NPT	2	1	19.25 x 19.50 x 39.68	20.00	1 1/4	2	3/4

Selected Humidifier Options:
- Type of Water:DI/RO
- DI/RO End Of Season Drain
- Evaporating Chamber Insulation
- Support Legs

Selected Control Options:
- VAPOR−LOGIC 4
- Building Automation System, ModBus
- Type of Control, Pneumatic Modulating
- Signal By, Others
- Control Cabinet

Selected Cabinet Options:
- Control Cabinet Mounted
- Keypad Mounted on Control Cabinet
- Keypad, Language, English
- Keypad, Unit Of Measure, Inch−Pound

Humidifier Notes:
DI/RO − Water shall contain no chloride.
Power block maximum wire connection size of 12 gauge.

Dispersion Inlet			Face Dimensions (inches)		Overall Dimensions (inches)	
Type	Diameter (inches)	Position	Width	Height	Width	Height
NPT	2	B3	22	12	25	21

Model	Qty.	Header Size (inches)	Tube Center (inches)	Condensate Position	
				Position #1	Position #2
ULTRA−SORB LV	1	3	3	NA	C7

AHU Conditions

Absorption Dist. (inches)	18	**Airflow**	Horizontal
Mounting Location	Coil	**Air Velocity (ft/min)**	927
Coil Width (inches)	22	**Airflow Pressure Drop (in.)**	0.050
Coil Height (inches)	12	**Entering RH (%)**	1
Entering Duct Temp (°F)	66.9	**Leaving RH (%)**	88
Leaving Duct Temp (°F)	72.0	**Heat Gain: Assembly (°F)**	1.73
Header Location	Inside AHU	**Heat Gain: Steam (°F)**	3.40
Water Seal Location	Inside AHU	**Load + Loss (lbs/hr)**	Not Calculated

Selected Dispersion Options:
- Casing, 304 Stainless Steel
- Extended Inlet, 12 (inches)

STS with DI/RO water option

The following is a description of the STS humidifier with the DI/RO water option proposed for use on the subject project.

Steam pressure is reduced to 15 PSI.

Tag	Quantity	Model	Capacity	Dispersion method	Duct dimensions (w x h)
AHU	one	STS-100S	109 lb/hr	Ultra-Sorb	22” x 12”

The above STS humidifier with the DI/RO water option is furnished with:

1. Evaporating chamber constructed of 14-gauge, type 304 stainless steel
2. Internal heat exchanger with supply and return headers
3. A(n) __pneumatic_____ 120V primary/24V secondary (to control flow of steam into heat exchanger)
4. Steam trap (¾” F&T trap for STS-25/50/100; 1¼” F&T trap for STS-200/400/800)
5. Wye strainer
6. Float fill valve
7. Vapor-logic®4 microprocessor-based control system with USB port for firmware updates and data backup and restore, and control using a Vapor-logic4 keypad and/or a Web interface. System maintains and monitors water level via a conductivity probe system.

   _____ Wall transmitter _____Duct transmitter

   __XX___ Control signal by others:

   _____0-10 VDC _____4-20 mA

   _____ Modulating high limit control; includes a duct mounted ±2% RH humidity transmitter (0% - 100% RH range)

   _____ Auxiliary temperature sensor/transmitter for temperature compensation control to prevent window condensation, or air temperature monitoring

   _____ Airflow proving switch:

   _____RH-3 pressure _____Sail

   _____ Duct high limit humidistat (30 - 90% RH)

   Interoperability with building automation system:

   _____Modbus® (standard) _____BACnet® (optional) _____LonTalk® (optional)

Optional equipment for STS with tap/softened water or with DI/RO water option

Optional items marked below are included with equipment submitted.

_____ 1. Multiple humidifier tank control

__X__ 2. Steam control valve

- __X__ Pneumatic
- _____ Electric 0 Vdc to 10 Vdc
- _____ Electric 4 mA to 20 mA
- _____ Valve by others
- _____ Pneumatic
- _____ Electric

_____ 3. Johnson Controls pneumatic humidistat H4100-203, 10% RH to 95% RH, 0 psi to 20 psi

_____ 4. Johnson Controls pneumatic duct high limit controller, H3610-1001

_____ 5. Johnson Controls pneumatic duct controller, H3610-1002

_____ 6. On-off duct mount humidistat, range 30% RH to 90% RH (may be used as high limit controller)

_____ 7. Airflow proving switch — prevents humidifier from operating without airflow

Electric Pneumatic Sail

XXXXX _ 8. Control cabinet mounted directly to humidifier

_____ 9. NEMA-4 enclosure for outdoor applications

XXXXX _ 10. Factory insulation — 1" semirigid foil-faced insulation (covering all surfaces except front of humidifier)

XXXXX _ 11. Support legs — brackets support humidifier 24 inches above floor. H-legs provided standard for STS-200/400/800

_____ 12. Outdoor enclosure: _____Roof curb _____Legs _____Flush mounting

_____ 13. Wall mounting brackets (not available for STS-200/400/800)

_____ 14. Ultra-sorb® Model XV steam dispersion panel
_____ Heat exchanger controlled by STS humidifier

XXXXX _ 15. Custom Ultra-sorb dispersion
_____ Insulated tube option

_____ 16. Custom Rapid-sorb® dispersion
_____ Insulated tube option

_____ 17. Steam hose kit — includes 10 feet of 1½" or 2" vapor hose, stainless steel dispersion tube, hose clamps, and escutcheon plates (to seal opening where tube penetrates duct)

_____ 18. Other _____

STS features and benefits

Reliable

- Consistent control to ±3% RH; control to ±1% RH with available options for specific applications; consult DRI-STEEM for recommendations
- Electronically monitored water level ensures continuous, safe operation
- Closed-loop system results in less wear on the boiler — no need to chemically treat make-up water for humidification

Efficient

- Utilizes energy from existing plant steam
- Most energy-efficient means of producing chemical-free steam with pressurized steam as the energy source

Flexible

- Easy retrofit for steam injection humidifiers
- Broad capacity range from 10 to 1600 lbs/hr (4.5 to 726 kg/h), link up to 16 units for capacity up to 25,600 lbs/hr (11,612 kg/h)
- Supports all fill water types: tap, softened, deionized, and reverse osmosis; easy field conversion if water type changes
- Suitable for all dispersion options
- Robust outdoor enclosure or weather cover options available for outdoor operation in any climate

Easy to maintain

- Cleanout plate and removable cover provide access to heat exchanger and tank without removing steam dispersion piping
- User-adjustable water skimmer eliminates floating minerals, while automatic drain and flush removes precipitated minerals; softened fill water significantly reduces maintenance requirements
- Heat exchanger sheds mineral buildup automatically
- End-of-season autodrain

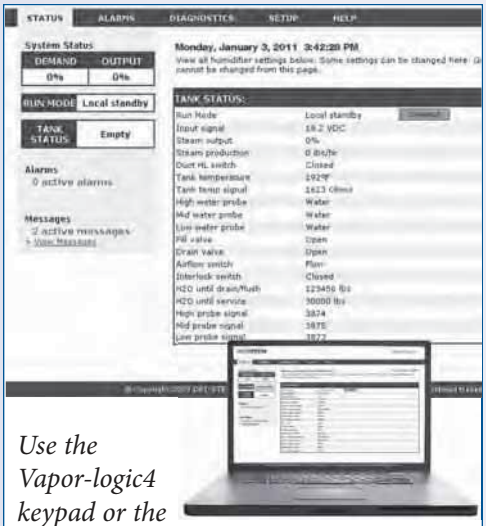
Ultra-sorb Model XV disperses STS-generated humidification steam with no condensate loss. See Page 26.

Ultra-sorb Model XV dispersion option

All STS models can be used with the Ultra-sorb Model XV steam dispersion panel:

- Zero water waste from condensate loss
- High-efficiency tubes and insulated header provide up to 85% reduction in wasted energy
- Steam capacity up to 450 lbs/hr (204 kg/h) per dispersion panel when used with STS

Vapor-logic4 controller



Use the Vapor-logic4 keypad or the standard Web interface, shown here, to control your STS humidification system.

Insert a USB flash drive into the Vapor-logic4 board's USB port to perform software updates, download data logs, and back up and restore data.

Accurate, responsive control

The Vapor-logic4 controller provides accurate, responsive RH control. PID control tunes the system for maximum performance.

Modbus, BACnet, or LonTalk allow interoperability with multiple building automation systems. Modbus is standard, and BACnet or LonTalk are available options.

Web interface provides the capability to set up, view, and adjust humidifier functions via Ethernet, either directly or remotely through a network.

USB port allows easy firmware updates, and data backup and restore capability.

Real-time clock allows time-stamped alarm and message tracking, and accurate drain and flush scheduling.

Auxiliary temperature sensor/transmitter allows air temperature monitoring, such as in a duct, and enables temperature compensation to prevent window condensation.

Programmable outputs allow remote signaling and device activation.

Multiple-humidifier control allows staged control of up to 16 humidifiers with one controller.

Controller data, such as RH, air temperature, water use, energy use, alarms, and messages, can be downloaded to a PC for viewing and analysis. RH, alarms, and service messages can also be displayed via the keypad or Web interface.

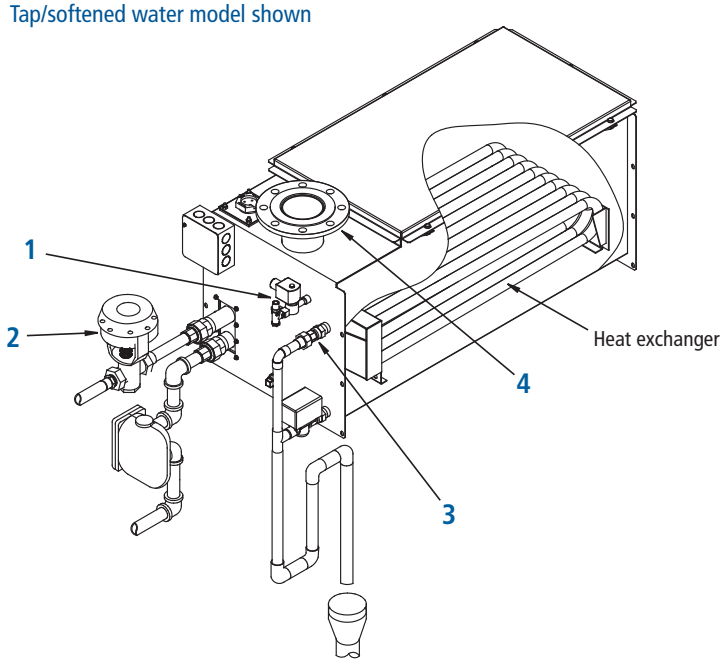
Enhanced diagnostics include:

- **Test outputs** function using keypad or Web interface to verify component operation
- **Test humidifier** function using simulated demand to validate performance

mc_042710_1500-STS

Figure 5-1:
STS principle of operation

Tap/softened water model shown



1. When the system is first activated, the fill valve opens, and the evaporating chamber fills with water to the operating level.
2. On a call for humidity, boiler steam passes through the valve to the heat exchanger, causing water in the evaporating chamber to boil. The fill valve opens and closes as needed to maintain the operating water level.
3. During refill in tap/softened water systems, a portion of the surface water is skimmed off, carrying away precipitated minerals.

   Humidifiers with the DI/RO water option (using deionized water or water that has been treated using reverse osmosis) do not require skimming.
4. Steam created in the evaporating chamber flows through steam hose, tubing, or piping to the dispersion assembly, where it is discharged into the airstream.

Figure 6-2:
Vapor-logic4 keypad/display

Figure 6-3
Removable cover

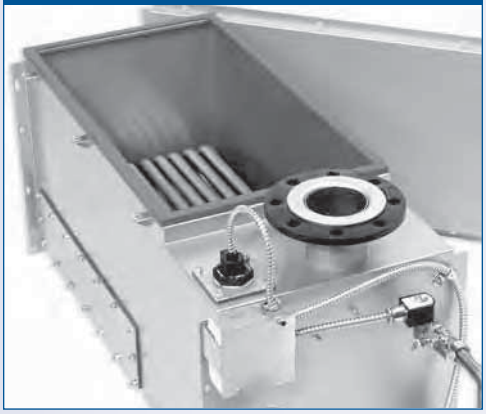


Figure 6-4:
Cleanout plate

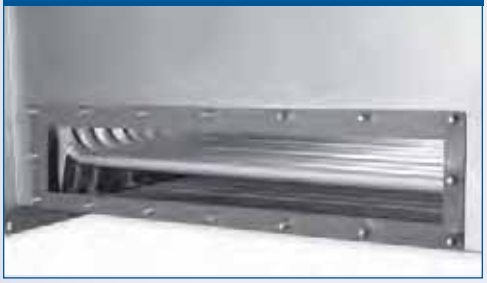
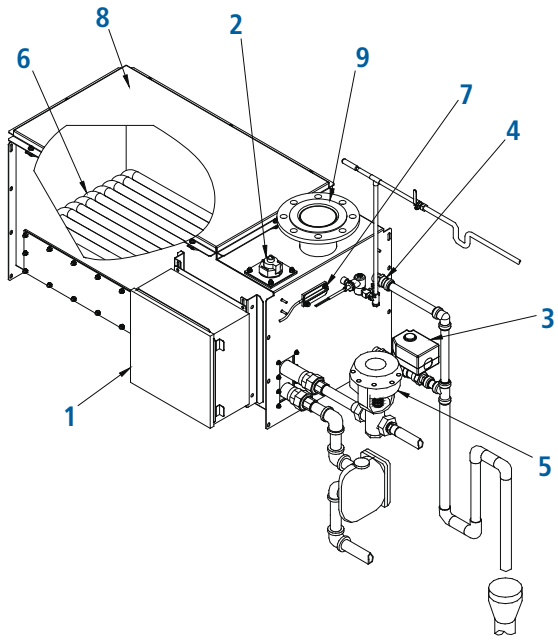


Figure 6-1:
STS components

Tap/softened water model shown



OM-7643

1. Vapor-logic4 controller

The Vapor-logic4 controller (in mounted control cabinet option shown above) controls all humidifier functions and can connect to a building automation system via Modbus or optional BACnet or LonTalk. See Page 4 for more information.

2. Water level control

Tap/softened water systems control water levels electronically using a three-rod probe (Figure 7-1).

Systems with the DI/RO water option control water levels using a float valve (Figure 7-2) and low-water cutoff switch.

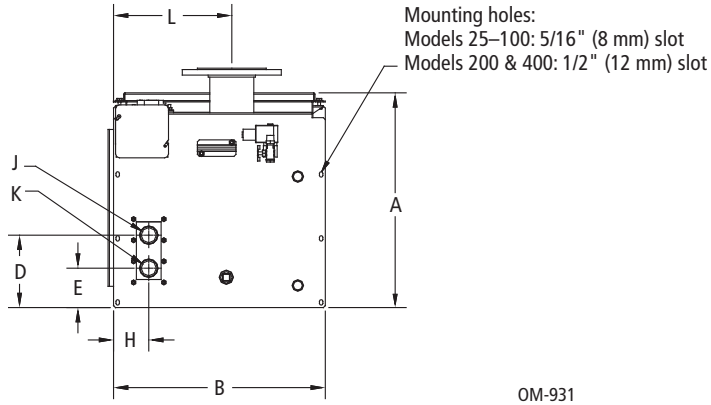
3. Drain

Tap/softened water humidifiers are programmed to automatically drain if there is no call for humidity after a user-defined time period (72-hour default).

Humidifiers with the DI/RO water option have a manual drain unless ordered with an electric drain to enable automated end of season draining.

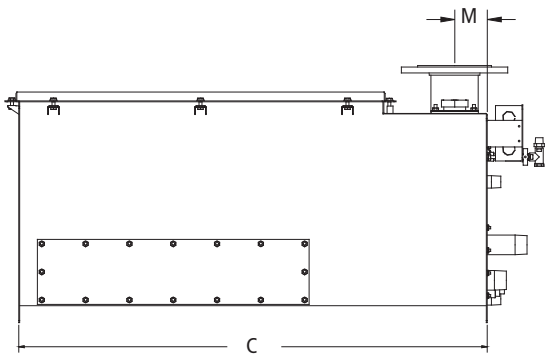
Figure 8-1:
Dimensions, STS models 25, 50, 100, 200, and 400 (with copper or stainless steel heat exchangers)

Front view



OM-931

Side view



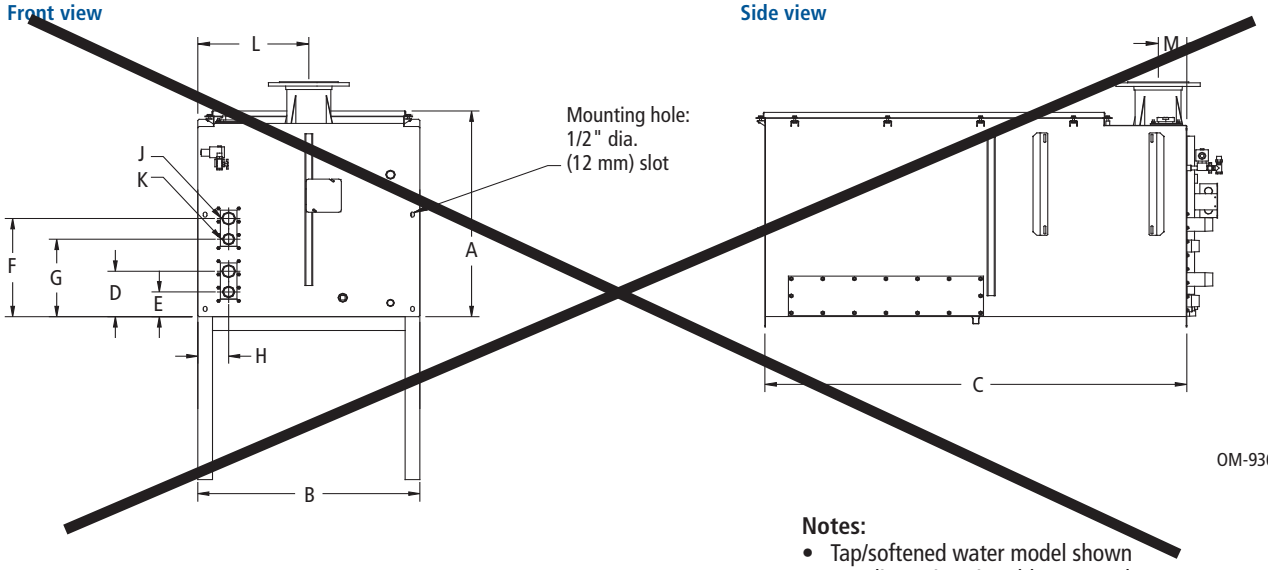
OM-932

Notes:
- Tap/softened water model shown
- See dimensions in Tables 9-1 and 9-2

mc_010511_1012-tap

Figure 8-2:
Dimensions, STS model 800 (with copper or stainless steel heat exchangers)

Front view



Side view

OM-936

Notes:
- Tap/softened water model shown
- See dimensions in Tables 9-1 and 9-2

mc_010511_1013-tap

STS dimensions

Table 9-1: Dimensions, STS with copper heat exchangers

	Description See drawings in Figures 8-1 and 8-2	STS model*									
		25C		50C		100C		400C		800C	
		inches	mm	inches	mm	inches	mm	inches	mm	inches	mm
A	Height**	19.50	495	19.50	495	19.50	495	19.50	495	29.75	756
B	Width	14.75	375	14.75	375	19.25	489	30.25	768	30.25	768
C	Length	23.65	600	39.65	1007	39.65	1007	55.15	1401	55.15	1401
D	Bottom to supply inlet of first heat exchanger	6.63	168	6.63	168	6.63	168	6.63	168	6.63	168
E	Bottom to return outlet of first heat exchanger	3.63	92	3.63	92	3.63	92	3.63	92	3.63	92
F	Bottom to supply inlet of second heat exchanger	—	—	—	—	—	—	—	—	14.28	363
G	Bottom to return outlet of second heat exchanger	—	—	—	—	—	—	—	—	11.24	285
H	Side to heat exchanger	3.25	83	3.25	83	3.25	83	3.25	83	3.25	83
J	Pressurized steam supply inlet	3/4" pipe thread	DN20	1¼" pipe thread	DN32	1¼" pipe thread	DN32	1½" pipe thread	DN40	1½" pipe thread	DN40
K	Pressurized steam return outlet	3/4" pipe thread	DN20	3/4" pipe thread	DN20	1¼" pipe thread	DN32	1¼" pipe thread	DN32	1¼" pipe thread	DN32
L	Side to steam outlet	6.25	159	8.63	219	9.63	245	13.00	330	13.00	330
M	Front to steam outlet	2.50	64	2.25	57	2.75	70	3.75	95	3.75	95

* **C**, **S**, and **SNC** in model numbers are explained in "Heat exchangers and water types" on Page 10.
**Add 23.5" (597 mm) to overall height when STS is mounted on four support legs. Add 22.5" (572 mm) to overall height when STS is mounted on two H-legs.

mc_010511_1010

Table 9-2: Dimensions, STS with stainless steel heat exchangers

	Description See drawings in Figures 8-1 and 8-2	STS model*											
		25S		50S		100S		200S		400SNC		800SNC	
		inches	mm	inches	mm	inches	mm	inches	mm	inches	mm	inches	mm
A	Height**	19.50	495	19.50	495	19.50	495	19.50	495	19.50	495	29.75	756
B	Width	14.75	375	14.75	375	19.25	489	30.25	768	30.25	768	30.25	768
C	Length	23.65	600	39.65	1007	39.65	1007	55.15	1401	55.15	1401	55.15	1401
D	Bottom to supply inlet of first heat exchanger	6.85	174	6.85	174	6.85	174	6.85	174	6.85	174	6.85	174
E	Bottom to return outlet of first heat exchanger	3.35	85	3.35	85	3.35	85	3.35	85	3.35	85	3.35	85
F	Bottom to supply inlet of second heat exchanger	—	—	—	—	—	—	—	—	—	—	14.5	368
G	Bottom to return outlet of second heat exchanger	—	—	—	—	—	—	—	—	—	—	11.0	279
H	Side to heat exchanger	3.25	83	3.25	83	3.25	83	3.25	83	3.25	83	3.25	83
J	Pressurized steam supply inlet	3/4" pipe thread	DN20	1" pipe thread	DN25	1" pipe thread	DN25	1¼" pipe thread	DN40	1½" pipe thread	DN40	1½" pipe thread	DN40
K	Pressurized steam return outlet	3/4" pipe thread	DN20	3/4" pipe thread	DN20	3/4" pipe thread	DN20	3/4" pipe thread	DN20	3/4" pipe thread	DN20	3/4" pipe thread	DN20
L	Side to steam outlet	6.25	159	8.63	219	9.63	245	13.00	330	13.00	330	13.00	330
M	Front to steam outlet	2.50	64	2.25	57	2.75	70	3.75	95	3.75	95	3.75	95

* **C**, **S**, and **SNC** in model numbers are explained in "Heat exchangers and water types" on Page 10.
**Add 23.5" (597 mm) to overall height when STS is mounted on four support legs. Add 22.5" (572 mm) to overall height when STS is mounted on two H-legs.

mc_010511_1011

Table 10-1:
Output capacities for STS models with copper heat exchangers

STS model	Steam pressure*							
	5 psi	34 kPa	10 psi	69 kPa	13 psi	90 kPa	15 psi	103 kPa
	lbs/hr	kg/h	lbs/hr	kg/h	lbs/hr	kg/h	lbs/hr	kg/h
25C	20	9	70	32	100	45	120	54
50C	50	23	150	68	200	91	240	109
100C	100	45	300	136	400	181	480	218
400C	300	136	580	263	720	327	790	358
800C	650	295	1275	578	1500	680	1600	726

* Steam pressure at connection to STS steam valve (valve provided by DRI-STEEM)

mc_010411_1645

Table 10-2:
Output capacities for STS models with stainless steel heat exchangers

STS model	Steam pressure*							
	5 psi	34 kPa	10 psi	69 kPa	13 psi	90 kPa	15 psi	103 kPa
	lbs/hr	kg/h	lbs/hr	kg/h	lbs/hr	kg/h	lbs/hr	kg/h
25S	10	5	25	11	30	14	35	16
50S	30	14	55	25	75	34	80	36
100S	60	27	110	50	140	64	150	68
200S	150	68	290	132	360	163	390	177
400SNC	170	77	392	178	552	250	637	289
800SNC	212	96	825	374	1095	497	1223	555

* Steam pressure at connection to STS steam valve (valve provided by DRI-STEEM)

mc_010411_1646

Heat exchangers and water types

For use with tap/softened or DI/RO water:

- STS models ending in **C** (copper heat exchangers with a nickel coating)
- STS models ending in **S** (stainless steel heat exchangers with a Teflon coating)

For use with DI/RO water option only:

- STS models ending in **SNC** (stainless steel heat exchangers with no coating)

Table 10-3:
STS weights

STS model	Shipping weight		Operating weight*	
	lbs	kg	lbs	kg
25	95	43	175	79
50	125	57	336	152
100	139	63	350	159
200	245	111	850	386
400	320	145	950	431
800	410	186	1450	658

* Operating weight does not include weight of interconnecting piping provided by installer.

mc_010411_1647

Figure 11-1: Support legs, STS models 25, 50, and 100 only

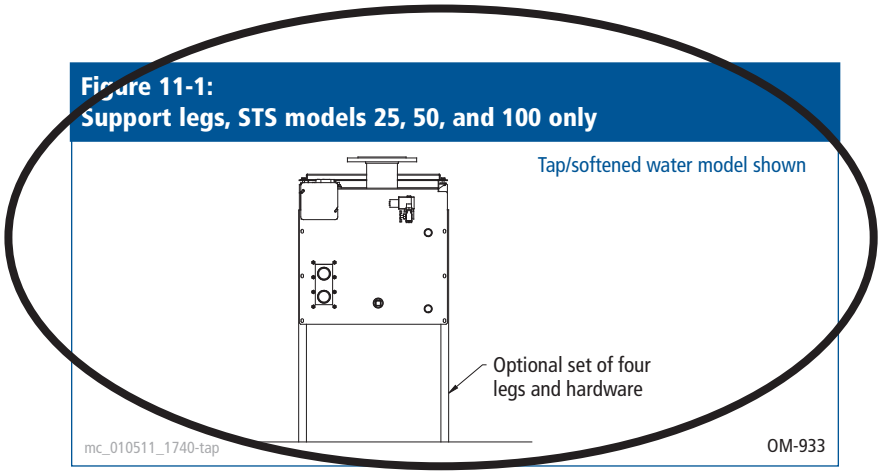
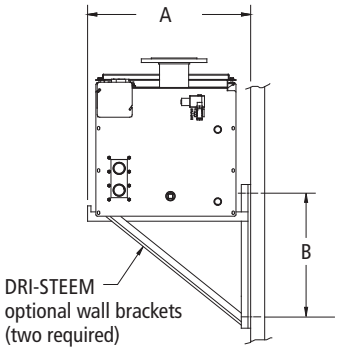


Figure 11-2: Wall brackets, STS models 25, 50, and 100 only



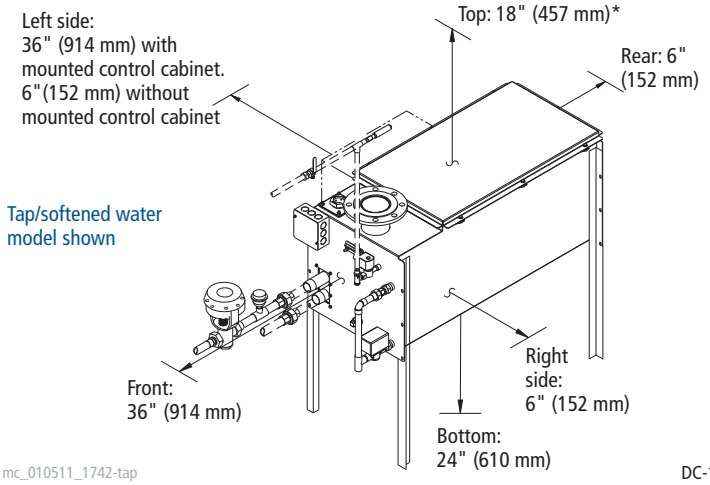
Tap/softened water model shown

STS model	A		B	
	in.	mm	in.	mm
25 and 50	15.5	394	24	610
100	21	533	30	762

DC-1454

Figure 11-3: Recommended clearances

* Minimum access clearance of 18" (457 mm) recommended for periodic removal of top cover for access to tank.


Left side: 36" (914 mm) with mounted control cabinet. 6"(152 mm) without mounted control cabinet
Top: 18" (457 mm)*
Rear: 6" (152 mm)
Tap/softened water model shown
Front: 36" (914 mm)
Right side: 6" (152 mm)
Bottom: 24" (610 mm)
mc_010511_1742-tap

DC-1452

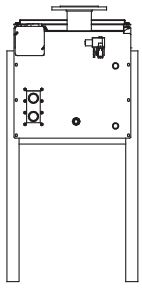
Table 11-1: STS mounting options

Mounting method	STS model	
	25, 50, 100	200, 400, 800
Trapeze hanger	standard	—
H-legs	—	standard
Support legs	optional	—
Wall brackets	optional	—

Figure 11-4: H-legs, STS models 200, 400, and 800 only

Tap/softened water model shown

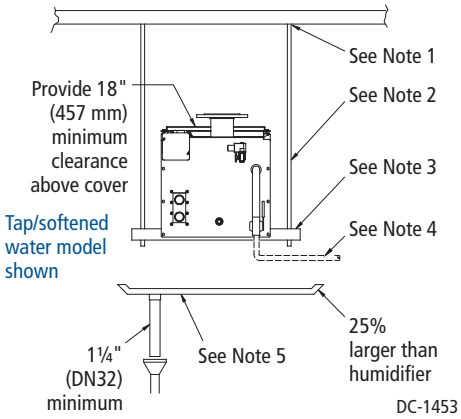
Due to size and weight, STS models 200, 400, and 800 must be mounted on H-legs.



mc_010511_1744-tap

OM-947

Figure 11-5: Trapeze hanger, STS models 25, 50, and 100 only



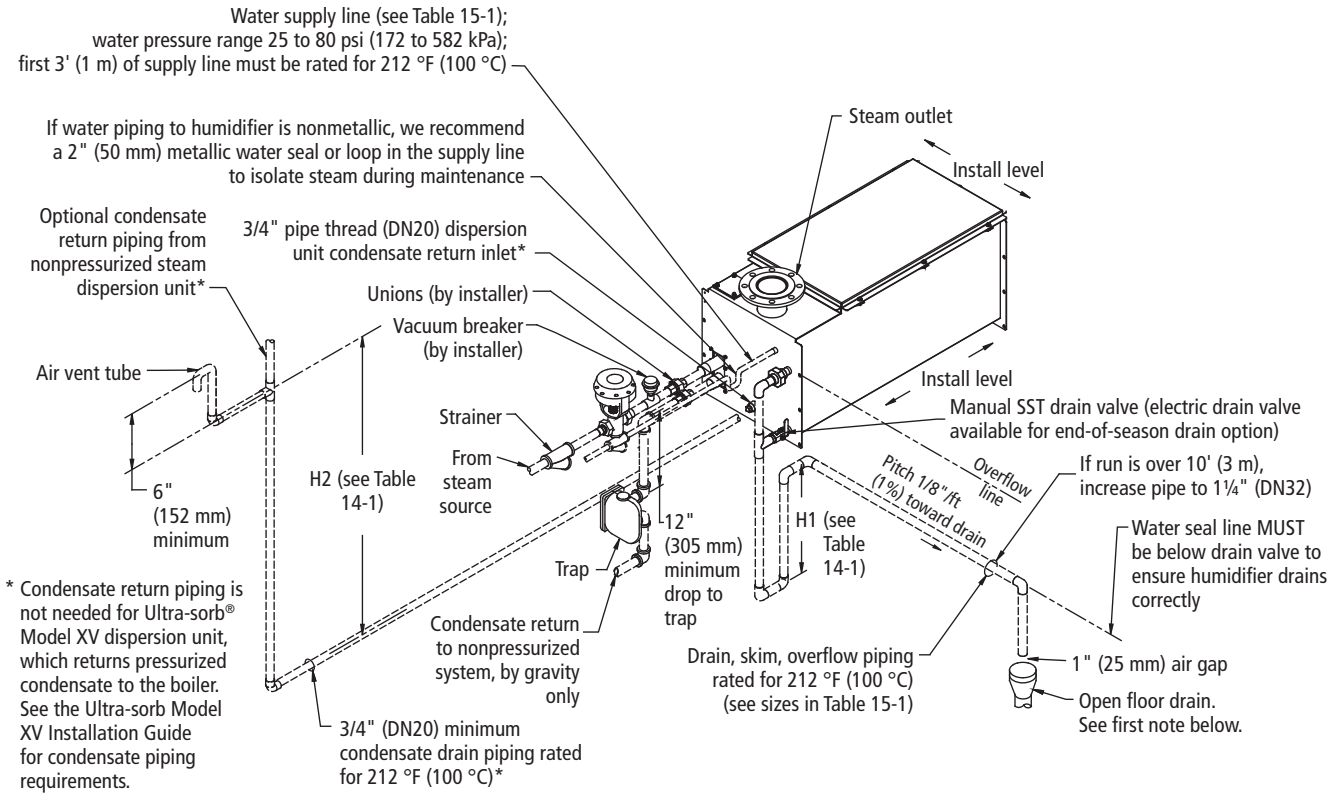
DC-1453

Notes:

1. Secure rods to overhead construction.
2. 3/8" (M10) threaded rod of length required.
3. Angle or channel sized to properly support humidifier.
4. Humidifier drain to appropriate building waste. Do not drain humidifier directly into drip pan. Install water seal as shown on Pages 12 through 15.
5. Drip pan (by installer) recommended in overhead installations to prevent possible water damage to equipment below.

STS piping: DI/RO water option, one heat exchanger

Figure 14-1:
Field piping overview for STS models 25, 50, 100, 200, and 400 with DI/RO water option


Water supply line (see Table 15-1); water pressure range 25 to 80 psi (172 to 582 kPa); first 3' (1 m) of supply line must be rated for 212 °F (100 °C)
If water piping to humidifier is nonmetallic, we recommend a 2" (50 mm) metallic water seal or loop in the supply line to isolate steam during maintenance
Optional condensate return piping from nonpressurized steam dispersion unit*
3/4" pipe thread (DN20) dispersion unit condensate return inlet*
Unions (by installer)
Vacuum breaker (by installer)
Air vent tube
6" (152 mm) minimum
H2 (see Table 14-1)
Strainer
From steam source
Trap
12" (305 mm) minimum drop to trap
Condensate return to nonpressurized system, by gravity only
3/4" (DN20) minimum condensate drain piping rated for 212 °F (100 °C)*
* Condensate return piping is not needed for Ultra-sorb® Model XV dispersion unit, which returns pressurized condensate to the boiler. See the Ultra-sorb Model XV Installation Guide for condensate piping requirements.
Steam outlet
Install level
Install level
Manual SST drain valve (electric drain valve available for end-of-season drain option)
Pitch 1/8"/ft (1%) toward drain
Overflow line
If run is over 10' (3 m), increase pipe to 1¼" (DN32)
H1 (see Table 14-1)
Water seal line MUST be below drain valve to ensure humidifier drains correctly
Drain, skim, overflow piping rated for 212 °F (100 °C) (see sizes in Table 15-1)
1" (25 mm) air gap
Open floor drain. See first note below.

Notes:

- Offset humidifier from floor drain to prevent flash steam from rising into the humidifier.
- Locate air gap only in spaces with adequate temperature and air movement to absorb flash steam; otherwise, condensation may form on nearby surfaces. Refer to governing codes for drain pipe size and maximum discharge water temperature.
- Water supply inlet is more than 1" (25 mm) above skim/overflow port, eliminating the possibility of backflow or siphoning from tank. No additional backflow prevention is required; however, governing codes prevail.
- Damage caused by chloride corrosion is not covered by your DRI-STEEM warranty.
- Dashed lines indicate provided by installer.

DC-1459

mc_010411_1556-di

Table 14-1:
Heights required to overcome humidifier internal pressure (H1, H2)

Unit output		Water seal height (H1)		Air vent height (H2)			
		All STS models		STS models			
				25, 50, 100, 200, 400		800	
lbs/hr	kg/h	inches	mm	inches	mm	inches	mm
≤ 138	≤ 62	12	305	27	686	—	—
139-183	63–83	15	381	30	762	—	—
> 183	> 83	18	457	33	838	42.25	1073

mc_010611_0730

Interconnecting steam hose, tubing, and pipe

Table 16-1:
Maximum steam carrying capacity and length of interconnecting steam hose, tubing, and pipe*

DRI-STEEM steam hose†††						Copper or stainless steel tubing and Schedule 40 steel pipe					
Hose I.D.		Maximum capacity		Maximum length**		Tube or pipe size***		Maximum capacity		Maximum developed length†	
inches	DN	lbs/hr	kg/h	ft	m	inches	DN	lbs/hr	kg/h	ft	m
2	50	250	113	10	3	2	50	220	100	30	9
						3††	80††	450	204	80	24
						4††	100††	750	340	100	30
						5††	125††	1400	635	100	30
						6††	150††	2300	1043	100	30

* Based on total maximum pressure drop in hose, tubing, or pipe of 5" wc (1244 Pa)
** Maximum recommended length for steam hose is 10' (3 m). Longer distances can cause kinking or low spots.
*** To minimize loss of capacity and efficiency, insulate tubing and pipe.
† Developed length equals measured length plus 50% of measured length to account for pipe fittings.
†† Requires flange connection.
††† When using steam hose, use DRI-STEEM steam hose for best results. Field-supplied hose may have shorter life and may cause foaming in the evaporating chamber resulting in condensate discharge at the dispersion assembly. Do not use steam hose for outdoor applications.

mc_091410_1050-STS

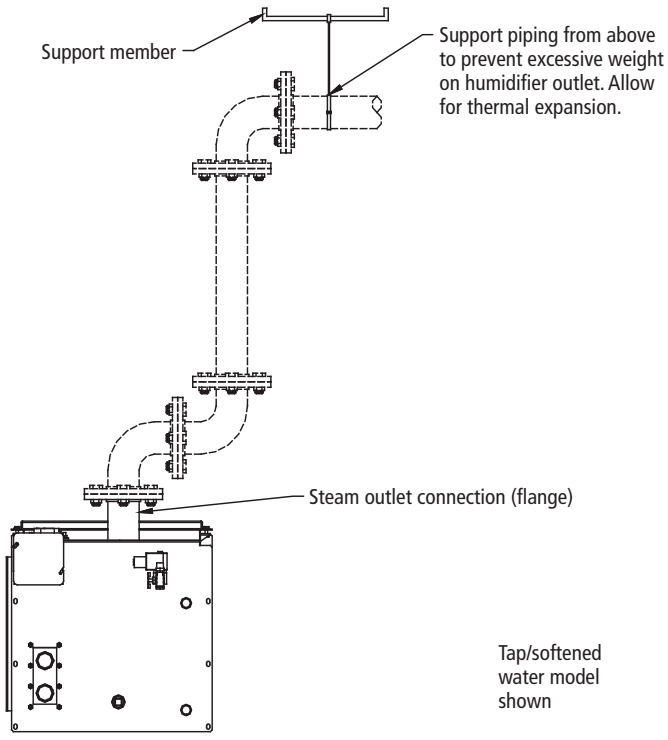
Table 17-1:
STS steam outlet sizes and types

STS model	Pipe thread size	Hose size	Flange size			
	2" (DN50)	2" (DN50)	3" (DN80)	4" (DN100)	5" (DN125)	6" (DN150)
25	X	X				
50	X	X	X			
100	X	X	X	X		
200			X	X	X	X
400			X	X	X	X
800				X	X	X

mc_010611_1100

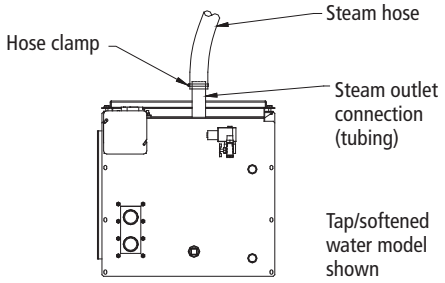
Figure 17-1:
Flange connection

Dashed lines indicate provided by installer


Support member
Support piping from above to prevent excessive weight on humidifier outlet. Allow for thermal expansion.
Steam outlet connection (flange)
Tap/softened water model shown

mc_010511_1745-tap DC-1458

Figure 17-2:
2-inch hose connection

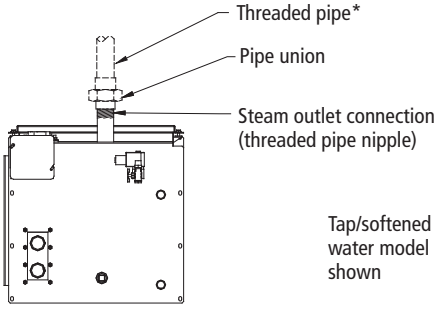


mc_010511_1748-tap DC-1455

Figure 17-3:
2-inch threaded pipe connection

Dashed lines indicate provided by installer

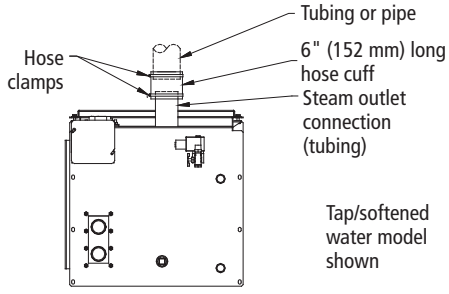
* Support pipe from above to prevent excessive weight on humidifier outlet. Allow for thermal expansion.



mc_010511_1747-tap DC-1456

Figure 17-4:
2-inch tubing or hard pipe connection using hose cuff with clamps

Dashed lines indicate provided by installer



mc_010511_1746-tap DC-1456

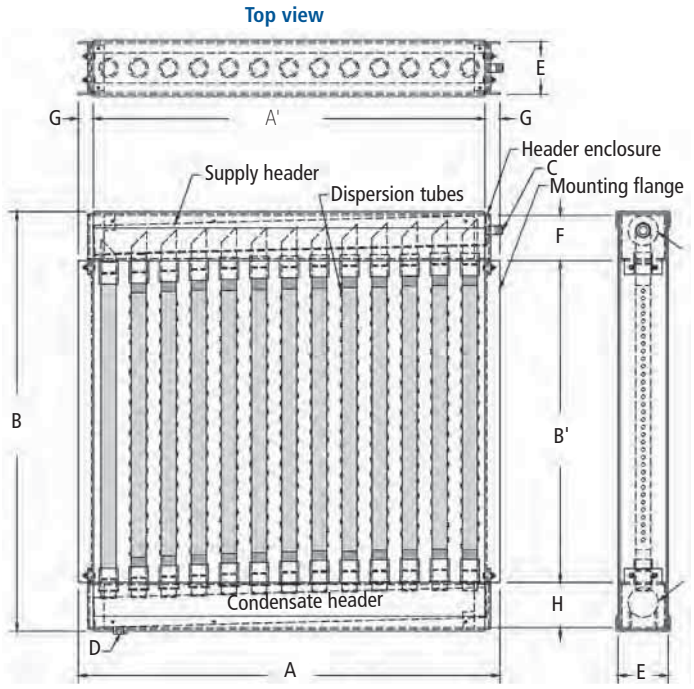
Ultra-sorb LV

- Vertical dispersion tubes
- Suitable for AHUs or ductwork
- Use when duct height is greater than duct width
- May use with pressurized or nonpressurized steam (horizontal airflow only)

Table 28-1:
Nonpressurized steam header capacities

Header capacity		Header diameter	
lbs/hr	kg/h	inches	DN
300	135	3	80
600	270	4	100
1100	500	5	125
1850	820	6	150

Figure 28-1:
Ultra-sorb LV dimensions



OM-123

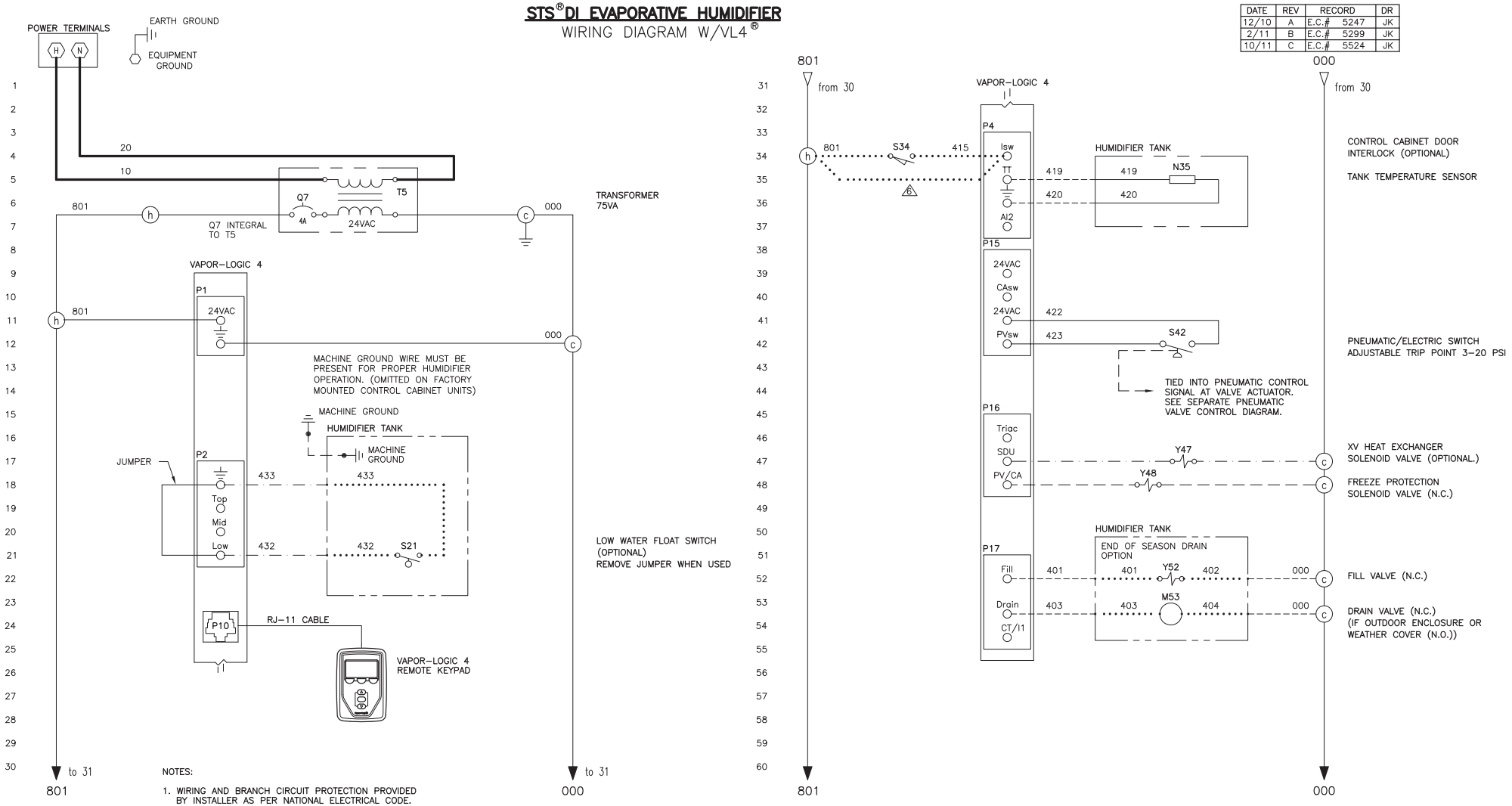
Table 28-2:
Ultra-sorb LV dimensions

A Overall width	15" (380 mm) min, 147" (3735 mm) max, in 1" (25 mm) increments
A' Face width	12" (305 mm) min, 144" (3660 mm) max, in 1" (25 mm) increments
B Overall height	21" (530 mm) min, 156" (3960 mm) max, in 1" (25 mm) increments Panels with overall height more than 98" (2490 mm) are shipped unassembled.
B' Face height	12" (305 mm) min, 144" (3660 mm) max, in 1" (25 mm) increments
C Steam inlet diameter	Determined by maximum steam capacity
D Condensate drain	¾" pipe thread (DN20)
E Header enclosure (front to back)	For 3" (DN80) and 4" (DN100) headers, E = 5" (127 mm); for 5" (DN125) header, E = 6" (152 mm); for 6" (DN150) header, E = 7" (178 mm)
F Header enclosure (top to bottom)	For 3" (DN80) header F = 4.5" (114 mm); for 4" (DN100) header, F = 5.5" (140 mm); for 5" (DN125) header, F = 6.5" (165 mm); for 6" (DN150) header F = 7.5" (191 mm)
G Flange	1.5" (38 mm)
H Condensate header enclosure	4.5" (114 mm)
Note: Header dimensions are determined by capacity. See Table 28-1.	

mc_050808_1215

STS® DI EVAPORATIVE HUMIDIFIER
WIRING DIAGRAM W/VL4®

DATE	REV	RECORD		DR
12/10	A	E.C.#	5247	JK
2/11	B	E.C.#	5299	JK
10/11	C	E.C.#	5524	JK



POWER WIRING
CONTROL CIRCUIT WIRING
FIELD WIRING
OPTIONAL FACTORY
OPTIONAL FIELD

NOTES:

1. WIRING AND BRANCH CIRCUIT PROTECTION PROVIDED BY INSTALLER AS PER NATIONAL ELECTRICAL CODE.
2. FOR SUPPLY AND MACHINE GROUND CONNECTIONS, SIZE WIRE USING 75°C WIRE TABLE PER NATIONAL ELECTRICAL CODE.
3. USE COPPER CONNECTORS RATED FOR 105°C.
4. INPUT LINE 120 VOLTS 1 PHASE, OPERATES ON 50/60 HERTZ.
5. POWER TERMINALS TORQUE 5 in-lbs
   GROUND LUG TORQUE 20 in-lbs
   CONTROL BLOCK TORQUE 5 in-lbs
   VL4 BOARD TORQUE 2.5 in-lbs
6. IF THE INTERLOCK SWITCH IS NOT USED, THEN WIRE DIRECTLY TO TERMINAL SWITCH.

BREAK TO EXTERNAL CONNECTIONS DIAGRAM

LEGEND

K	RELAY/CONTACTOR	Y	SOLENOID
T	TRANSFORMER	N	SENSOR
Q	CIRCUIT BREAKER	J	JUMPER
S	SWITCH	E	WATER PROBE
H	HEATER	M	MOTOR/FAN

MODEL: _____

ORDER NO: _____

STEAM PRESSURE: _____ PSI

STEAM OUTPUT (LBS/HR): _____

DRISTEEM®

DOMESTIC STS, DI WATER PNEUMATIC ACTUATOR WIRING DIAGRAM

MAT'L:

SCALE:

DRAWN BY: KROG

DATE: 12/15/10

P/N STS-VL4-2

VB-7263 Precision Globe Valves

Globe Valves

VB-7263 series single seat, stem up to close, two-way valves control water from 20 to 340°F (-7 to 171°C) or saturated steam to 340°F (171°C) max. in heating or air conditioning systems. These valves have stainless steel trim with a PTFE disc. They are used for two-position or proportional control applications. Valve assemblies require an actuator and a valve linkage that must be purchased separately.

- RoHS compliant product is environmentally friendly and meet standard before the requirement.
- High rangeability provides fine accurate fluid control for more efficient, responsive and comfortable regulation.
- Tight sealing with ultra low energy leakage on shutoff for improved system efficiency.

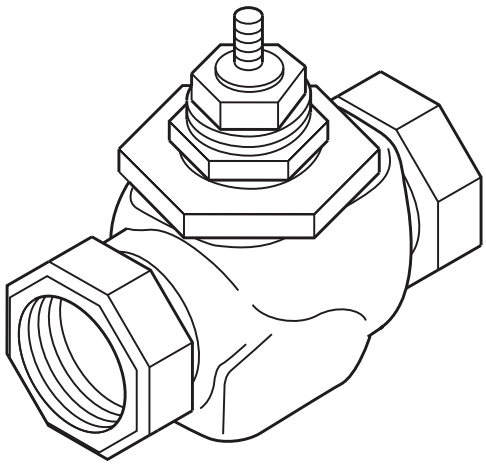
- Caution: Do not use for combustible gas applications. The VB-7263 series valve packings are not rated for combustible gas applications, and if used in these applications, gas leaks and explosions could result.

Schneider Electric

Specifications

Action	Stem Up Closed
Sizes	1/2" to 2"
ANSI Pressure Class	250 (up to 400 psig below 150°)
ANSI Seat Leakage	Designed to ANSI V up to 35 psi (241 kPa), ANSI IV up to 87 psi (600kPa) with long term seat leakage dependent on proper water conditioning and maintenance of the water system [d]
Control Media Temperature	20 to 340° F (-7 to 171° C) water (up to 60% glycol/water solution), pressurized treated steam
Allowable ΔP for Water [b]	87 psi (600 kPa) Max for normal life. [a]
Maximum inlet pressure saturated steam	100 psig (690 kPa)
Max ΔP for sizing, saturated steam	80% of inlet pressure up to 15 psig and 42% of absolute inlet pressure above 15 psig inlet
Max ΔP at close-off, saturated steam	Inlet pressure (actuator must be rated to provide close-off pressure)
Listings/Certifications	RoHS Compliant, PED, CRN
Body Pattern	NPT Threaded

Valve Size	Cv	Kvs[c]	Rangeability	Valve Body Part Number
1/2"	0.1	0.09	Over 13 to 1	VB-7263-0-4-31
	0.22	0.19	Over 18 to 1	VB-7263-0-4-33
	0.4	0.35	Over 100 to 1	VB-7263-0-4-01
	0.75	0.65	Over 100 to 1	VB-7263-0-4-34
	1	0.87	Over 100 to 1	VB-7263-0-4-36
	1.3	1.1	Over 100 to 1	VB-7263-0-4-02
	1.8	1.6	Over 100 to 1	VB-7263-0-4-28
	2.2	1.9	Over 100 to 1	VB-7263-0-4-03
	2.9	2.5	Over 100 to 1	VB-7263-0-4-30
	3.25	2.8	Over 100 to 1	VB-7263-0-4-39
	4.4	3.8	Over 100 to 1	VB-7263-0-4-04
3/4"	5.5	4.8	Over 100 to 1	VB-7263-0-4-05
	6.3	5.4	Over 100 to 1	VB-7263-0-4-41
	7.5	6.5	Over 100 to 1	VB-7263-0-4-06
1"	8.2	7.1	Over 100 to 1	VB-7263-0-4-51
	9	7.8	Over 100 to 1	VB-7263-0-4-52
	10	8.7	Over 100 to 1	VB-7263-0-4-07
	12	10	Over 100 to 1	VB-7263-0-4-08
1-1/4"	14	12	Over 100 to 1	VB-7263-0-4-61
	16	14	Over 100 to 1	VB-7263-0-4-62
	18	16	Over 100 to 1	VB-7263-0-4-63
	20	17	Over 100 to 1	VB-7263-0-4-09
1-1/2"	22	19	Over 100 to 1	VB-7263-0-4-71
	24	21	Over 100 to 1	VB-7263-0-4-72
	28	24	Over 100 to 1	VB-7263-0-4-10
2"	31	27	Over 100 to 1	VB-7263-0-4-81
	34	29	Over 100 to 1	VB-7263-0-4-82
	40	35	Over 100 to 1	VB-7263-0-4-11



Materials

Body	Bronze
Seat	316 Stainless Steel
Stem	316 Stainless Steel
Plug	316 Stainless Steel
Packing	Spring-Loaded TFE/EPDM
Disc	PTFE

Notes:

a. To minimize noise, ensure the flow rate in the piping is less than three meters (10ft)/second and the differential pressure is less than 35 psi (241 kpa). Operating within the cavitation zone or an operating differential pressure above 35 psi (241 kpa) may result in noise.

b. Maximum recommended differential pressure in open position. Do not exceed recommended differential pressure (pressure drop) or integrity of parts may be affected. Exceeding maximum recommended differential pressure voids product warranty.

c. kvs = m3/h (ΔP = 100 kPa) Cv = kvs x 1.156

d. Requires properly conditioned waterper EN-205 Water System Guideline, F-26080. Actuator close off force recommendations must be observed to meet ANSI Class V.

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Normal Position of Valve Actuator Assembly

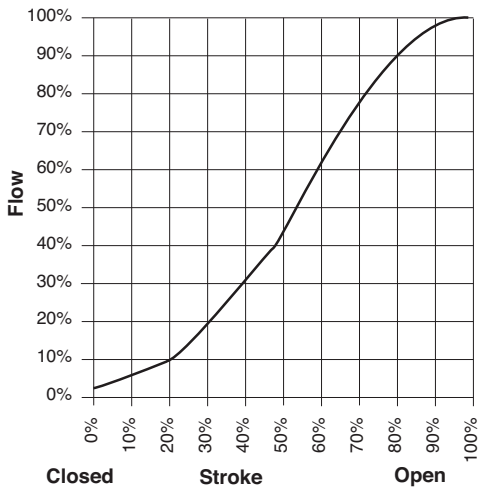
Actuator Series	Actuator Type	Required Valve Linkage	Normal Position
Mx51-710x-xxx	Electric	None	Normally Closed
Mx51-720x-xxx		None	Normally Closed
M900AR-xx-VB		None	Normally Closed
M900AE-xx-VB		None	Normally Open
M900AR-xx		AV-821	Normally Closed
M900AE-xx		AV-821	Normally Open
MA-521X		AV-7600a	Normally Closed
MK-2690	Pneumatic	AV-7400	Normally Closed
MK-46x1		AV-401	Normally Closed
MK-66x1		AV-430	Normally Closed
MP-521x	Electric	AV-7600a	Normally Closed
MP-541x		AV-7600 & AV-601	Normally Closed
MPR-561x			Normally Closed
MP-551X			Normally Closed
Mx-2223x3, Mx-23xx3		None	None
M400A-xx-VB, M800A-xx-VB, M1500A-xx-VB		None	None
M400A-xx, M800A-xx, M1500A-xx		AV-821	None
DuraDrive Damper Actuators [b]		AV-611 for 1/2" to 1-1/4" Valves	Normally Closed, Normally Open, or none
DuraDrive Damper Actuators [b]		AV-602 for 1" to 2" Valves	Normally Closed, Normally Open, or none

a High ambient temperatures with high media temperatures in the valve may require the use of the AV-601 in addition to the AV-7600.

* Refer to the the AV-611 General Instructions, F-27410 and the AV-602 General Instructions, F-26914 for compatible actuator information

Flow Characteristics

All valves have modified linear flow characteristics. That is, the flow rate is nominally proportional to the valve plug lift, at a constant differential pressure.

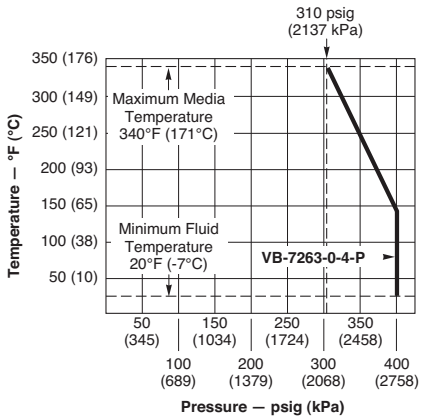


Temperature Pressure Ratings

Consult the appropriate valve linkage general instruction sheet for the effect of valve body ambient temperatures on specific actuators. Ratings conform with published values and disclaimer.

VB-7263-0-x-P (Cast Bronze Body)

Standards: Pressure to ANSI B16.15 Class 250 with 400 psig up to 150°F decreasing to 310 psig at 340°F



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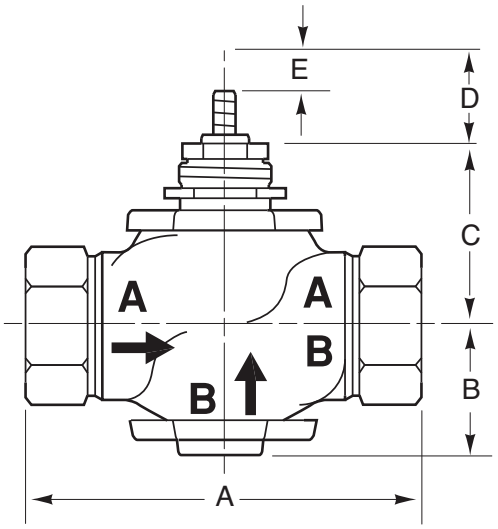
VB-7263-0-4-P,

Valve Port Code (P)	Valve Size	Dimensions in Inches (mm)				
		A	B	C	D*	E
01, 02, 03, 04, 28, 30, 31, 33, 34, 36, 39	1/2”	3-1/16 (78)	1-1/4 (32)	1-11/16 (43)	3/4 (19)	7-16 (11)
05, 06, 41	3/4”	3-5/8 (92)				
07, 08, 51, 52	1”	4-5/8 (118)	1-3/4 (45)	1-3/4 (45)		
09, 61, 62, 63	1-1/4”			2 (51)		
10, 71, 72	1-1/2”	5-3/8 (137)	1-13/16 (49)	2-1/16 (54)		
11, 81, 82	2”	6-1/8 (156)	2-1/16 (53)	2-3/16 (56)		

* Stem down



Additional Information

For more information, download these documents from our website.

- CA-28 Control Valve Sizing, F-13755
- Valve Selection Chart Water, F-11080
- Valve Selection Chart Saturated steam, F-11366
- VB-7000 Installation Instructions, F-27651

Specifications are nominal and subject to change without notice.

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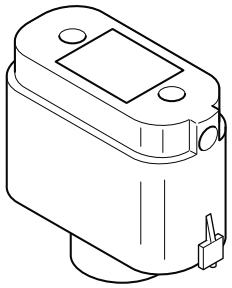
MK-2690

Pneumatic Valve Actuator

For proportional pneumatic control of 1/2 in. to 2 in. VB-7XXX Series valves (subject to close-off ratings) and 1/2 in. to 1-1/4 in. VB-9XXX valves.



Features:

- Compact size with 6 in.^{2} (39 cm^2) effective area.
  Rugged die cast aluminum housing.
  Replaceable beaded molded neoprene diaphragm.

Model Chart

Model No.	Nominal Spring Range[a] (Spring Color Code)	
	psig	kPa
MK-2690		
	8 to 13 (Blue)	55 to 90

[a] Nominal (no load) condition, spring ranges based on 1/2 in. (13 mm) maximum stroke, provided by AV-7400 linkage (order separately).

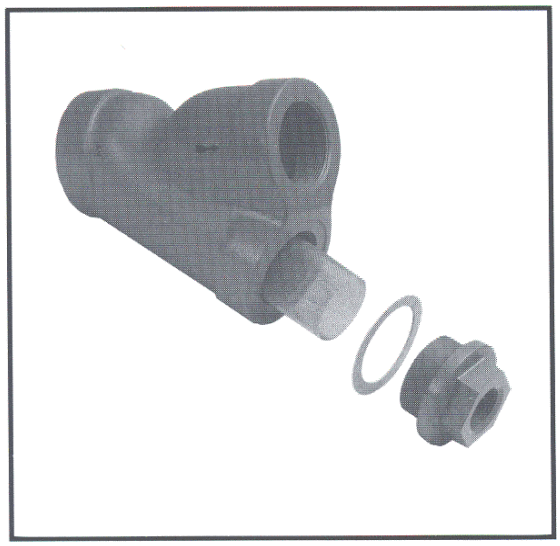
Specifications

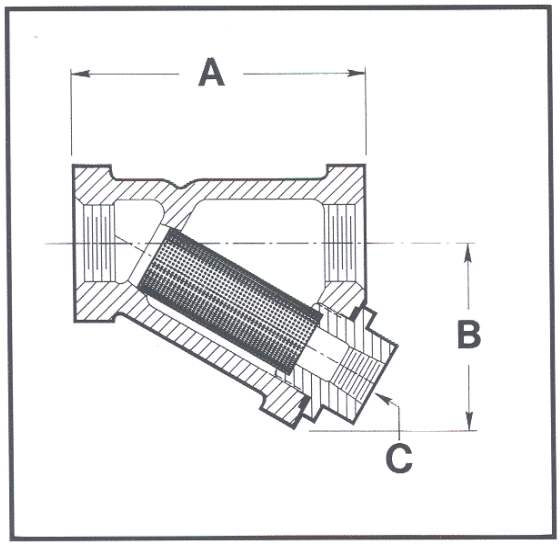
Inputs Compatible with	Proportional pneumatic signal. Refer to Model Chart.
Start point	Non-adjustable.
Air connections	1/8 in. FNPT located on side of housing.
Mechanical Outputs	
Stroke	1/2 in. (12.6 mm) nominal.
Environment	
Ambient temperature limits	Shipping: -40 to 220°F (-40 to 104°C). Operating: -20 to 220°F (-29 to 104°C).
Humidity	5 to 95% RH, non-condensing.
Location	NEMA Type 1.
Maximum air pressure	30 psig (207 kPa).
Spring	Retracts actuator shaft and raises valve stem on loss of air pressure. Springs provided in AV-400 linkage (order separately).
Dimensions	3-9/16 H x 5 W x 2-1/4 D in. (90 x 127 x 57 mm).

Accessories

Model No.	Description
AK-42309-500	Positive positioner and linkage; use with MK-2690-0-0-1 or MK-2690-0-0-2 models only.
AV-400	Valve linkage (includes parts for VB-7XXX and VB-9XXX valves).
AV-7400	Valve linkage for VB-7XXX valves only.
TOOL-95-1	Pneumatic calibration tool kit.
PNV-144-043	3 to 7 yellow spring.
PNV-145-044	5 to 10 black spring.
PNV-145-043	8 to 13 blue spring.
PNV-102-1	Diaphragm.

Model #11M-N - Cast Iron Screwed End





Pressure-Temperature Ratings	
Steam	250 PSI @ 400° F
WOG	400 PSI @ 100° F

Service Recommendations
The model 11M-N is designed to remove foreign matter from pipe lines and provide economical protection for costly pumps, meters, valves and other similar mechanical equipment.

Screens
20 mesh stainless steel screens (1/32" openings) are normally furnished in all sizes through 2" for water service. The 2-1/2" and 3" sizes are furnished with 1/16" openings for water.

Construction
The upstream end of the screen is securely held in place by the tapered seat in the body of the strainer. The other end is secured by a machined seat in the straight threaded, gasketed cap. All sizes are available with NPT blowoff plugs (see letter "C" in the table for sizes). Blowoff plug not normally furnished.

Blowoff Outlets
We recommend a blowdown valve connected to the blowoff outlet in the cap. With the proper precautions, this is a fast and easy way to clean the strainer without shutting down the system.

Individually Hydrostatically Tested
All strainers are individually tested in accordance with industry wide accepted standards.

Materials

Body & Cap	Cast Iron ASTM A126 Grade B	
Screen	304 Stainless Steel ASTM A240	
Water	1/4"-2"	20 mesh
	2-1/2", 3	1/16" perf.
Gasket	Non-asbestos	

Dimensions and Weights (Approximate "Apply for Certified Drawings")

Size in / mm	1/4" 8	3/8" 10	1/2" 15	3/4" 20	1" 25	1-1/4" 32	1-1/2" 40	2" 50	2-1/2" 65	3" 80
A	3-3/16	3-3/16	3-3/16	3-3/4	4	5	5-3/4	7	9-1/4	10
B	2-1/16	2-1/16	2-1/16	2-7/16	2-5/8	3-3/8	3-7/8	4-3/4	5-7/8	6
C	1/4	1/4	1/4	3/8	3/8	3/4	3/4	1	1-1/2	1-1/2
Weight lb	1.6	1.6	1.6	2.4	3	5.2	8	12.5	22	30

MARSHALL ENGINEERED PRODUCTS CO.

FORM 1510N

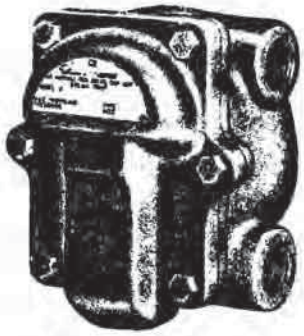
SPECIALTIES

FLOAT & THERMOSTATIC TRAP - 40 SERIES/CLOSED FLOAT TRAP - 41 SERIES

FOR OPERATING PRESSURES UP TO 125 LBS.

APPLICATION

The MEPCO Float & Thermostatic Traps 40 series, and Closed Float Traps 41 series are applicable to all types of steam pressure heating systems and steam process equipment. The **40 series traps'** purpose is to move air and water while preventing steam fro entering the return piping. The **41 series traps'** purpose is to move water while preventing steam from entering the return piping. Thes traps are manufactured in (32) models for handling capacities of 27 to 4,075 lbs of condensate per hour and operate efficiently with pressures up to 125 lbs.



FEATURES & BENEFITS

1. Simple, rugged construction. This MEPCO trap is a mechanically simple and durable combination of a float and thermostatic trap. All working parts are made of non-corrosive metals especially adapted for this service.

2. Sensitive thermostatic action. Charging the thermostatic disc under high vacuum assures sensitive and positive response to temperature and pressure over entire operating range. Disc corrugations are shaped to reduce hinge action at the rim of the disc and evenly distribute disc motion. (Not applicable to the 31 series, closed float trap).

3. Instantaneous valve action. Design of the float valve assembly permits rapid and positive valve action. Location of the valve assures a deep water seal at all times.

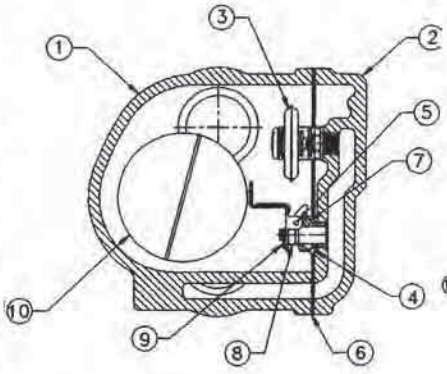
4. Continuous rapid flow of water. A lever operated discharge valve opens wide so that large volumes of water can flow continuously from trap.

5. Thorough testing. In addition to tests made of the completed trap, each thermostatic disc is tested before it is assembled into the trap.

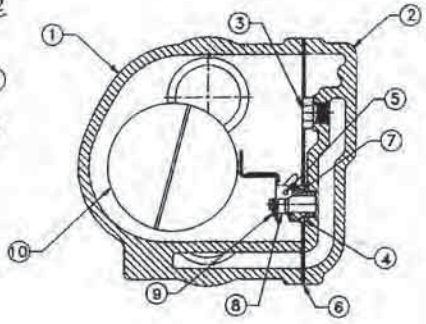
6. Minimum maintenance. All working parts may be inspected, removed or repaired without disturbing piping connections.

PARTS/MATERIALS - ***40 & 41 series***

ITEM	PART	MATERIAL
1	Body	Class 30 Cast Iron
2	Cap	Class 30 Cast Iron
3	Disc (series 40)	SST & Brass
3	Plug (series 41)	Brass
4	Hinge	Brass
5	Pin, hinge	Stainless Steel
6	Gasket	Non-asbestos Fiber
7	Seat	SST & Brass holder
8	Valve	Stainless Steel
9	Clip	Stainless Steel
10	Lever & Float	Stainless Steel



Series 40



Series 41

MEPCO RESERVES THE RIGHT TO MAKE CHANGES IN SPECIFICATIONS AND DESIGN WITHOUT NOTICE

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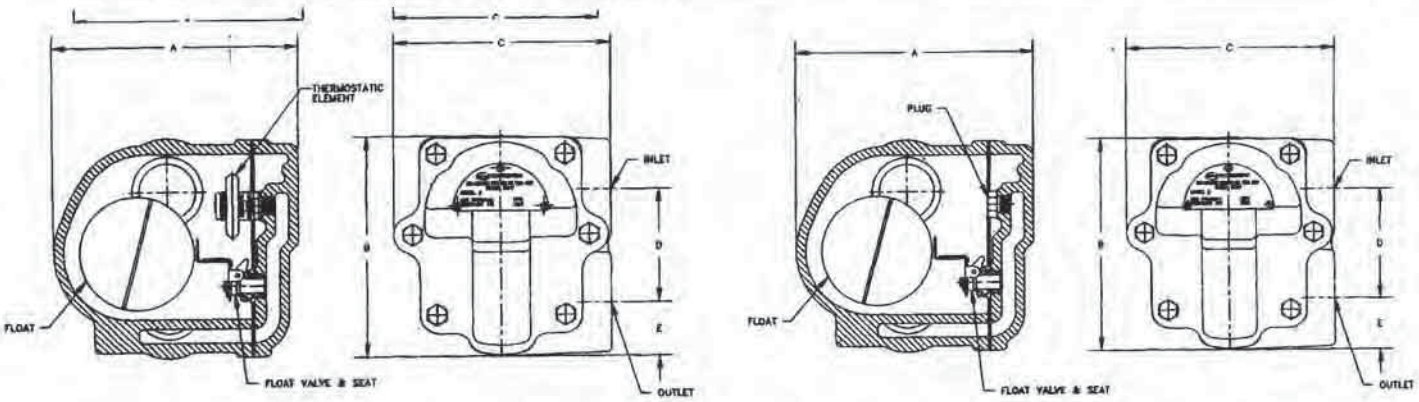
Dimensions and Capacities



NOTE: The **40 series** (with thermostatic element) & the **41 series** (with brass plug) share the same dimensions and capacities.

40 & 41 Series

	Model NO.	-215A -415A	-515A	-715A	-230A -430A	-530A	-730A	-275A -475A	-575A	-775A	-2125A -4125A	-5125A	-7125A
	NPT SIZE	3/4"/1"	1-1/4"	1-1/2"	3/4"/1"	1-1/4"	1-1/2"	3/4"/1"	1-1/4"	1-1/2"	3/4"/1"	1-1/4"	1-1/2"
	ORIFICE	.313	.344	.391	.250	.313	.391	.141	.188	.219	.109	.141	.172
PRESSURE DIFFERENTIAL PSI	1/4	600	750	980	425	600	800	300	375	400	275	300	350
	1/2	825	1,000	1,365	600	825	1,100	375	500	525	310	375	450
	1	1,000	1,200	1,855	750	1,000	1,450	425	600	675	350	425	550
	2	1,225	1,400	2,410	900	1,225	1,800	500	710	825	390	525	650
	5	1,575	1,900	3,150	1,250	1,575	2,400	625	935	1,075	450	625	800
	10	1,875	2,300	3,750	1,500	1,875	2,900	725	1,050	1,250	500	725	950
	15	2,175	2,700	4,075	1,725	2,175	3,400	825	1,225	1,425	540	825	1,050
	20				1,900	2,500	3,750	900	1,375	1,575	600	900	1,150
	25				2,050	2,750	4,050	975	1,525	1,725	660	975	1,275
	30				2,300	3,000	4,300	1,000	1,675	1,850	725	1,100	1,400
	40							1,200	1,825	2,000	850	1,200	1,500
	50							1,350	1,950	2,200	1,000	1,350	1,625
	60							1,500	2,100	2,400	1,100	1,500	1,780
	75							1,650	2,400	2,700	1,280	1,650	1,950
	90										1,410	1,825	2,100
	100										1,500	1,900	2,275
	125										1,650	2,100	2,500
DIMENSIONS	A	5-3/4	6-3/8	6-3/8	5-3/4	6-3/8	6-3/8	5-3/4	6-3/8	6-3/8	5-3/4	6-3/8	6-3/8
	B	5-3/4	5-3/4	5-3/4	5-3/4	5-3/4	5-3/4	5-3/4	5-3/4	5-3/4	5-3/4	5-3/4	5-3/4
	C	4-7/8	5-3/8	5-3/8	4-7/8	5-3/8	5-3/8	4-7/8	5-3/8	5-3/8	4-7/8	5-3/8	5-3/8
	D	3-3/8	3	3	3-3/8	3	3	3-3/8	3	3	3-3/8	3	3
	E	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-3/8
	WGT	10 lbs.	13 lbs.	13lbs.	10 lbs.	13 lbs.	13 lbs.	10 lbs.	13 lbs.	13 lbs.	10 lbs.	13 lbs.	13 lbs.

Capacities given are continuous discharge capacities in pounds of condensate per hour at pressure differential indicated, determined by tests conducted according to ASME Performance test Code 39.1.1980. Apply safety factor as required per application. Condensate within 5 degrees of steam temperature.

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FORM 1510N

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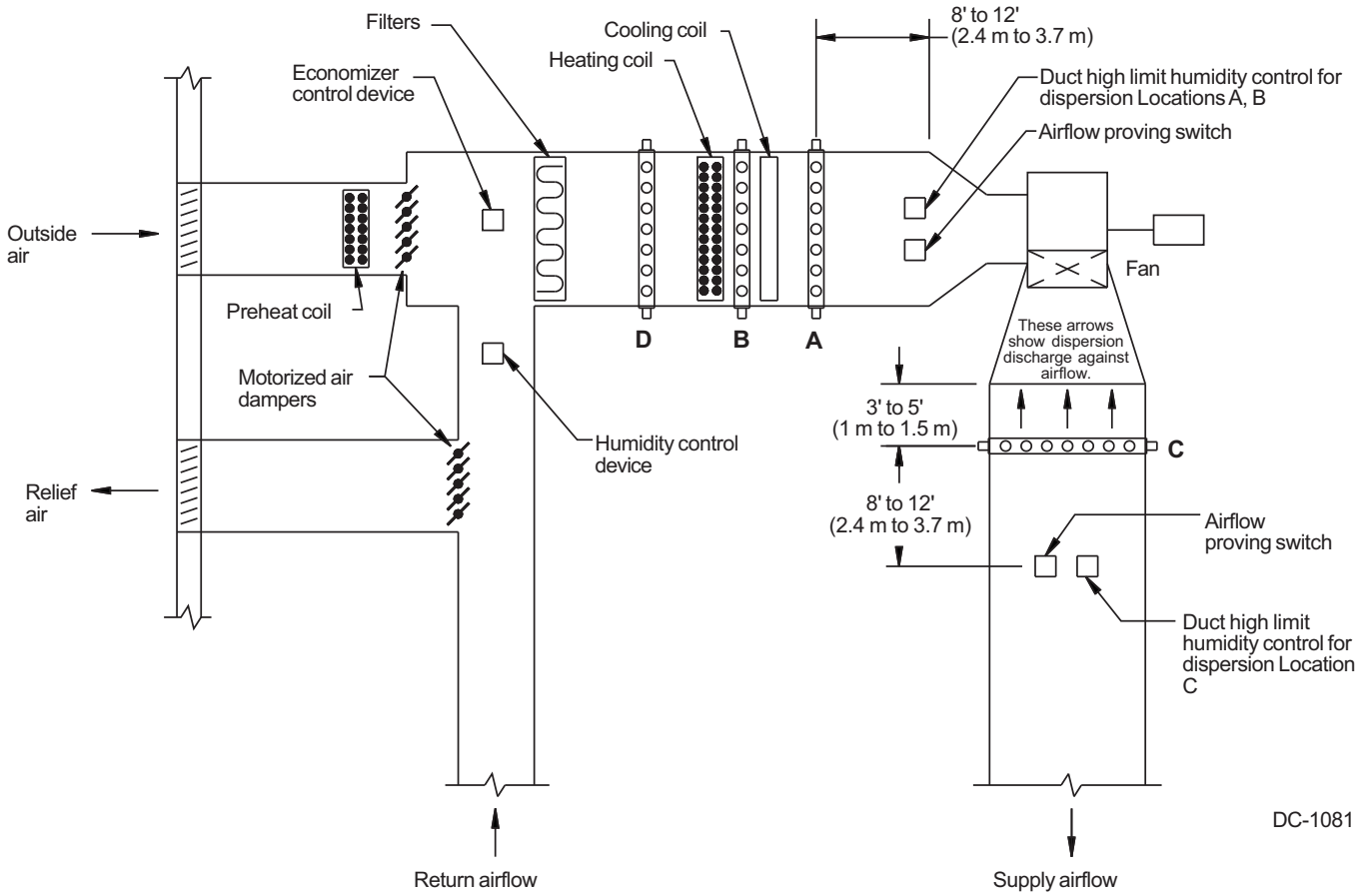
Installation Guide

Humidifier dispersion and humidity sensor placement

Usually, there is no single correct placement for a humidifier dispersion unit. Much depends on the system design, its uses, and its applications. However, the following examples are presented as practical guidelines for some of the more common situations.

Example 1: Placement of a dispersion unit in an air handling unit



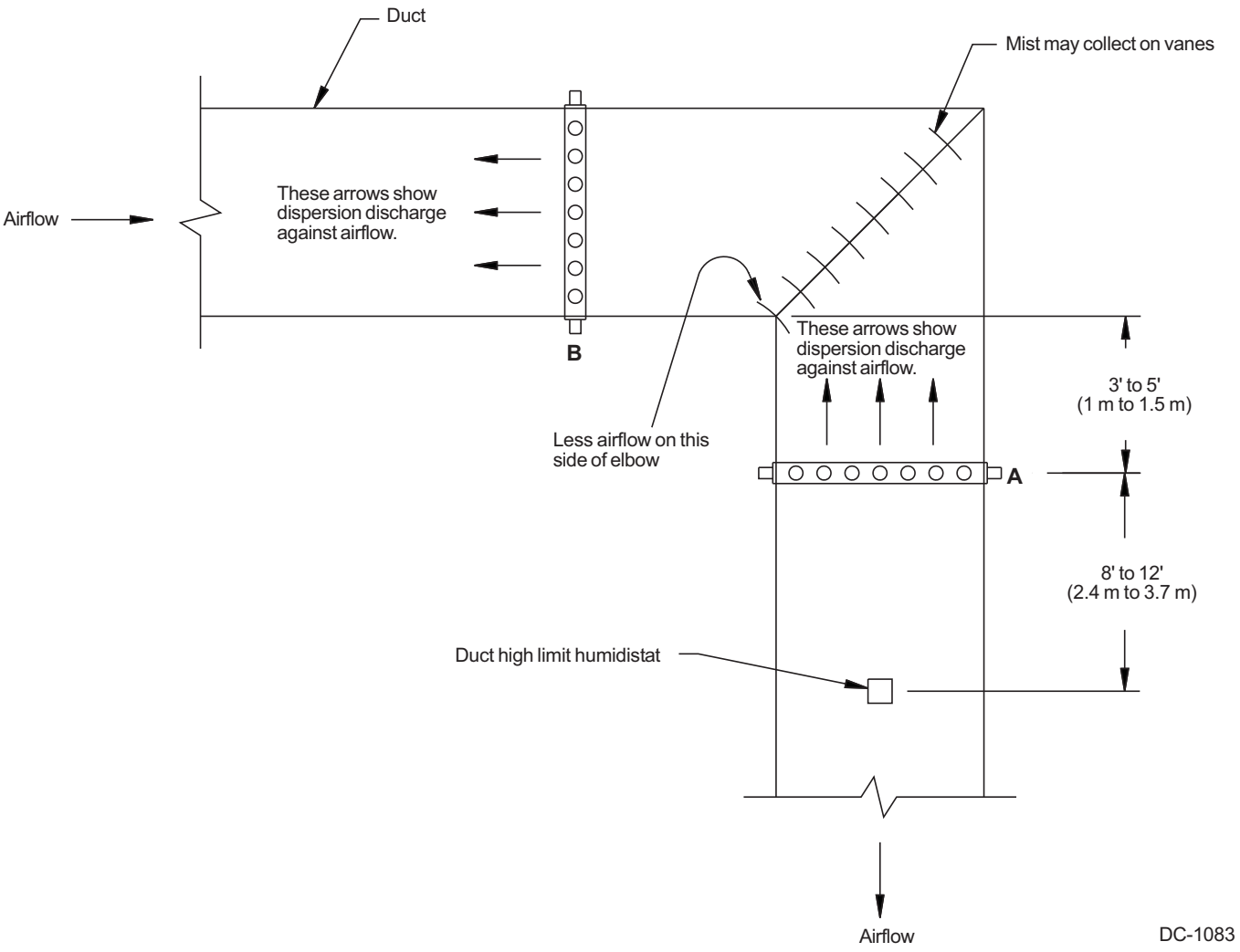
Location A is the best choice. Installing downstream of heating and cooling coils provides laminar flow through the dispersion unit, plus the heated air provides an environment for best absorption. Use a multiple tube dispersion unit to ensure complete absorption of steam vapor before fan entry.

Location B is the second-best choice. However, in change-over periods, the cooling coil can eliminate some moisture for humidification.

Location C is the third-best choice. Air leaving a fan is usually turbulent and can cause vapor to not absorb at the expected absorption distance. Allow for more absorption distance if installing downstream of a fan.

Location D is the poorest choice. The cooler air at this location requires an increased absorption distance.

Example 2: Placement of a dispersion unit near an elbow


Duct
Mist may collect on vanes
Airflow
These arrows show dispersion discharge against airflow.
B
These arrows show dispersion discharge against airflow.
3' to 5' (1 m to 1.5 m)
Less airflow on this side of elbow
A
8' to 12' (2.4 m to 3.7 m)
Duct high limit humidistat
Airflow
DC-1083

Location A is the best choice. Better absorption occurs on the downstream side of an elbow than on the upstream side.

Location B is the second-best choice. Installing upstream of an elbow can cause wetting at the turning vanes. In cases where it is structurally impossible to avoid Location B, use a multiple tube dispersion unit to ensure complete absorption. Also, since more air flows along the outside of a turn, better absorption occurs if the humidifier discharges proportionately more steam in that part of the airstream.

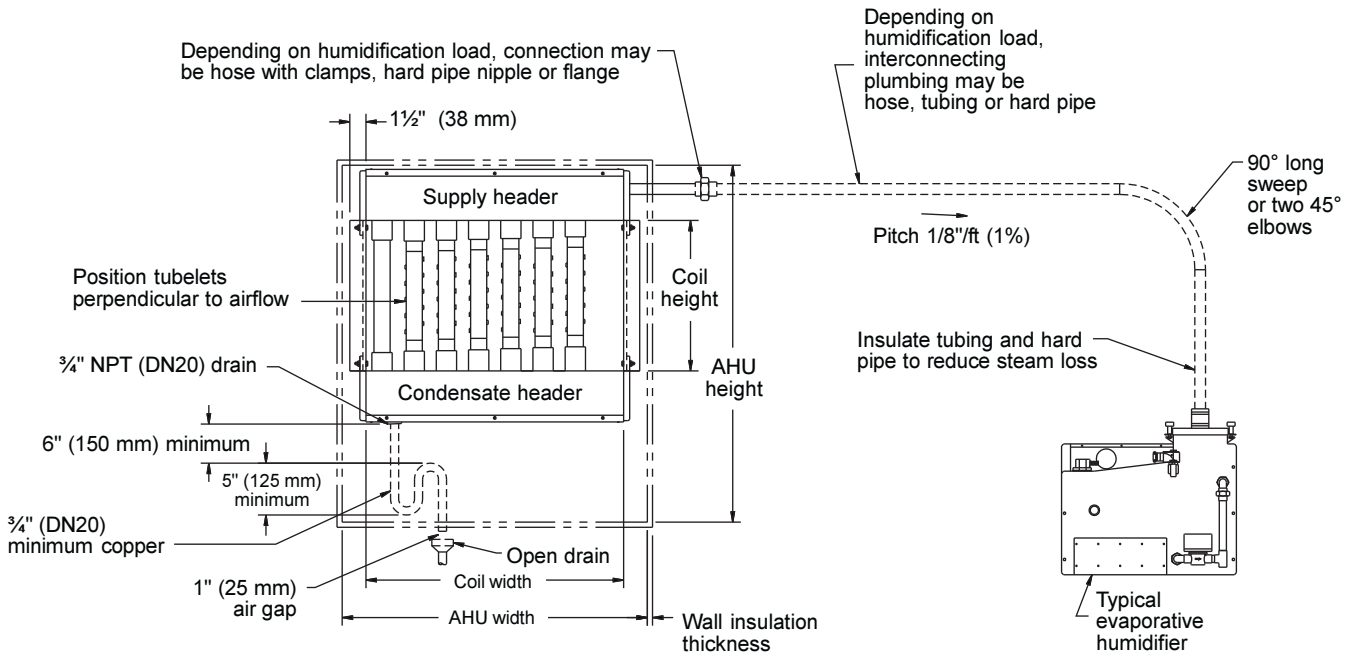
At both locations, discharging steam against or perpendicular to the airstream gives slightly better mixing and absorption than discharging with the airstream.

Installation Guide

ULTRA-SORB® Model LV, installed in an AHU horizontal airflow

(for use with evaporative steam)

Field piping overview, elevation


Depending on humidification load, connection may be hose with clamps, hard pipe nipple or flange
1½" (38 mm)
Supply header
Position tubelets perpendicular to airflow
¾" NPT (DN20) drain
Condensate header
6" (150 mm) minimum
5" (125 mm) minimum
¾" (DN20) minimum copper
1" (25 mm) air gap
Open drain
Coil width
AHU width
Coil height
AHU height
Wall insulation thickness
Depending on humidification load, interconnecting plumbing may be hose, tubing or hard pipe
Pitch 1/8"/ft (1%)
90° long sweep or two 45° elbows
Insulate tubing and hard pipe to reduce steam loss
Typical evaporative humidifier

Note: Dashed lines indicate provided by installer.

DC-1098

Maximum steam carrying capacity and length of interconnecting vapor hose, tubing and pipe*

Vapor hose						Copper or stainless steel tubing and Schedule 40 steel pipe					
Hose I.D.		Maximum capacity		Maximum length**		Tube or pipe size***		Maximum capacity		Maximum developed length†	
inches	DN	lbs/hr	kg/h	ft	m	inches	DN	lbs/hr	kg/h	ft	m
1½	40	150	68	10	3	1½	40	150	68	20	6.1
2	50	250	113	10	3	2	50	220	100	30	9.2
						3††	75††	450	204	80	24.4
						4††	100††	750	340	100	30.5
						5††	125††	1400	635	100	30.5
						6††	150††	2300	1043	100	30.5

Notes:

* Based on total maximum pressure drop in hose, tubing or piping of 5" wc (1244 Pa)

** Maximum recommended length for vapor hose is 10' (3 m). Longer distances may cause kinking or low spots.

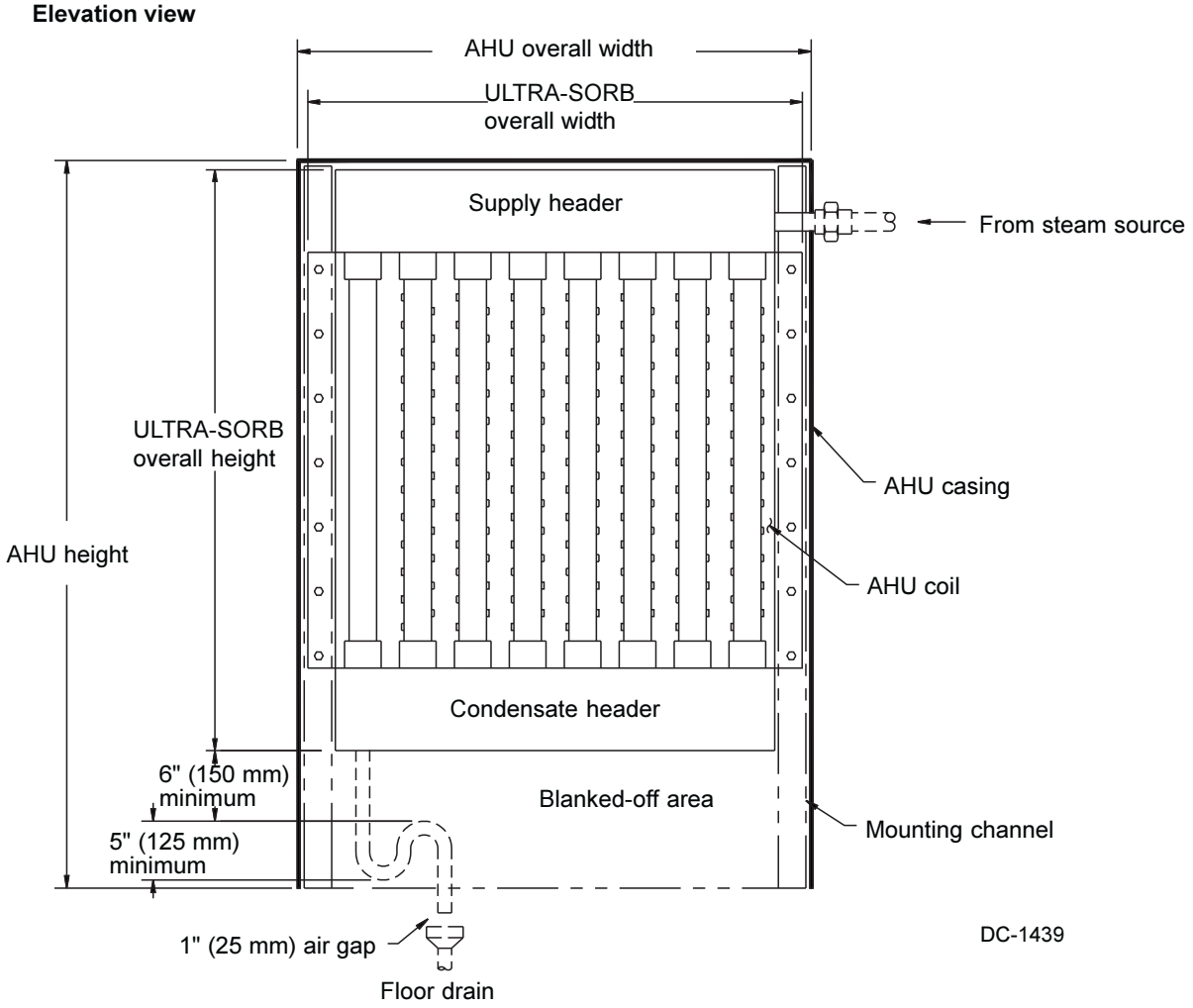
*** To minimize loss of capacity and efficiency, insulate tubing and piping.

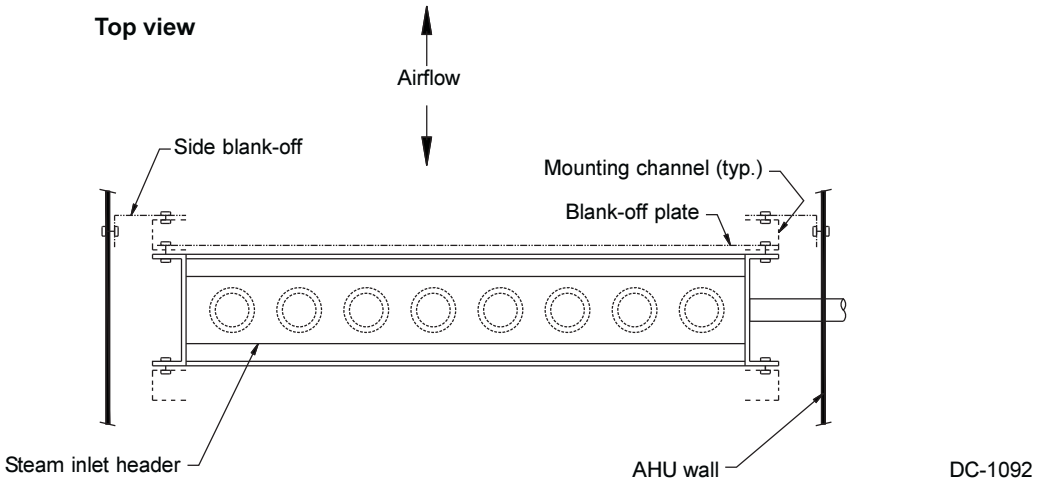
† Developed length equals measured length plus 50% of measured length, to account for pipe fittings.

†† Requires flange connection

Mounting an ULTRA-SORB® panel in an AHU

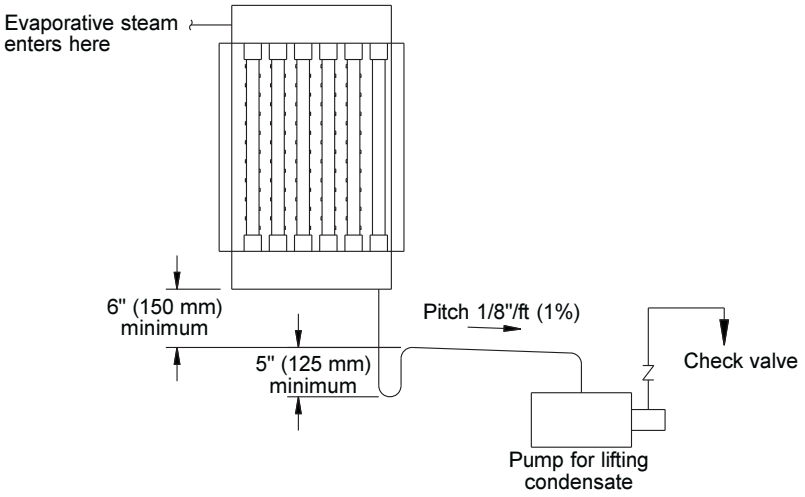
To ensure uniform airflow across the face of the ULTRA-SORB panel in an AHU, install it immediately downstream of a heating or cooling coil. The ULTRA-SORB panel is contained within a mounting frame. Mounting flanges with a width of 1½" (38 mm) are provided on two sides of the unit. In addition, a 1½"-wide (38 mm) portion of each header enclosure is intended to be a mounting flange. Anchor the ULTRA-SORB mounting frame to the AHU wall. Use a No. 12 x ¾" (M6 x 20 mm) self-drilling and -tapping screw, with spacing not to exceed 12" (305 mm). **Note: Screw penetration into header enclosure should not exceed ¾" (20 mm) to avoid puncturing header.** Headers are pitched to accommodate vertical mounting.





Draining and lifting condensate

Since the ULTRA-SORB® operates with virtually zero internal pressure, condensate cannot be piped directly into a return main and, therefore, should either be wasted to a floor drain or piped into a small condensate pump for return to the steam source. In either case, the drain connection of the ULTRA-SORB must be at an elevation that will permit gravity drainage. To prevent steam from escaping from the drain line, install a water seal P-trap in the drain line. See drawing below for water seal height. For lifting condensate, use DRI-STEEM condensate pump (Part No. 400280 for 115 V or Part No. 400281 for 230 V) rated for 212 °F (100 °C) and suitable for lifting 250 gph (16 L/m) with a 20-foot head (60 kPa).



DC-1095

Steam loss of interconnecting vapor hose, tubing or pipe

Description	Nominal hose, tubing or pipe size		Steam loss				Insulation thickness	
			Noninsulated		Insulated			
	inches	DN	lbs/hr/ft	kg/h/m	lbs/hr/ft	kg/h/m	inches	mm
Hose	1.5	40	0.15	0.22	N/A	N/A	N/A	N/A
	2.0	50	0.20	0.30	N/A	N/A	N/A	N/A
Tubing	1.5	40	0.11	0.164	0.02	0.03	2.0	50
	2.0	50	0.14	0.21	0.025	0.037	2.0	50
	3.0	80	0.20	0.30	0.03	0.045	2.5	63
	4.0	100	0.26	0.39	0.03	0.045	3.0	75
	5.0	125	0.31	0.46	0.035	0.052	3.0	75
	6.0	150	0.36	0.54	0.039	0.058	3.0	75
Pipe	1.5	40	0.22	0.33	0.02	0.03	2.0	50
	2.0	50	0.25	0.38	0.025	0.037	2.0	50
	3.0	80	0.39	0.58	0.03	0.045	2.5	63
	4.0	100	0.49	0.73	0.03	0.045	3.0	75
	5.0	125	0.59	0.88	0.035	0.052	3.0	75
	6.0	150	0.70	1.04	0.039	0.058	3.0	75

Notes:

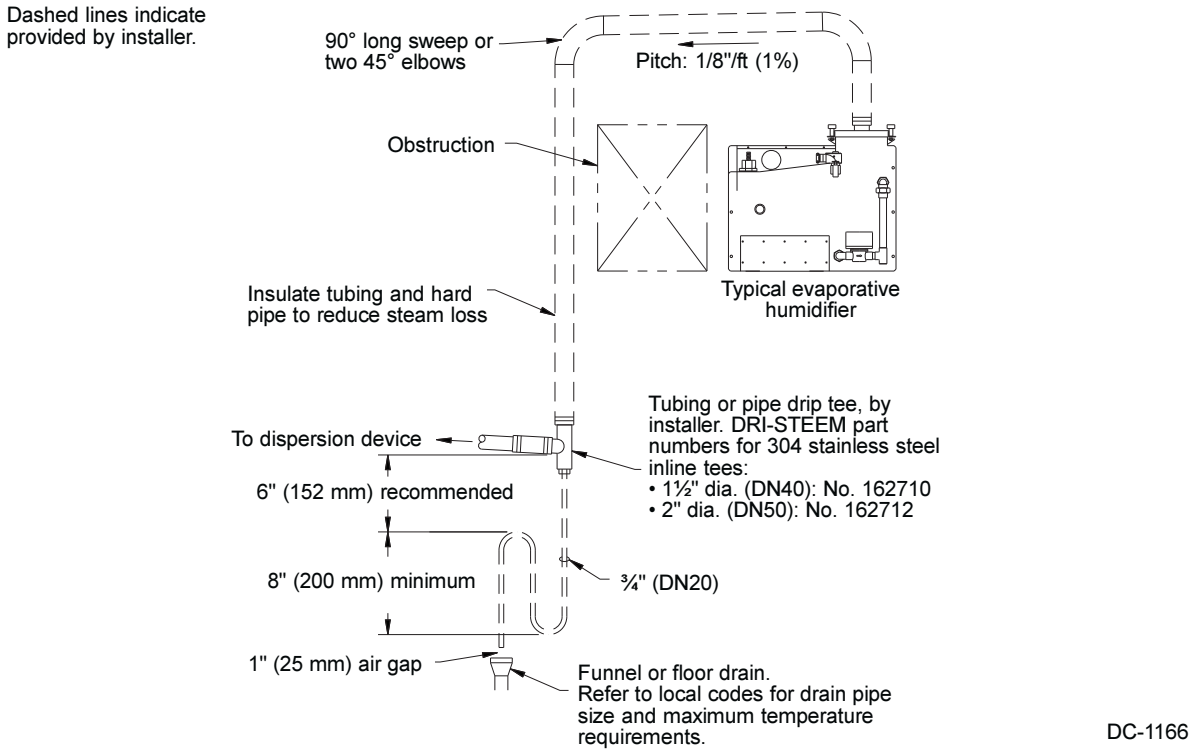
This data is based on an ambient air temperature of 80 °F (26.7 °C), fiberglass insulation, copper tubing, and Schedule 40 pipe.

$$\text{lbs/hr/ft} = \frac{\text{Btu/hr/ft}}{970\ \text{Btu/lb}} \qquad \text{kg/hr/m} = \frac{\text{Btu/hr/m}}{1444\ \text{Btu/kg}}$$

Drip tee installation

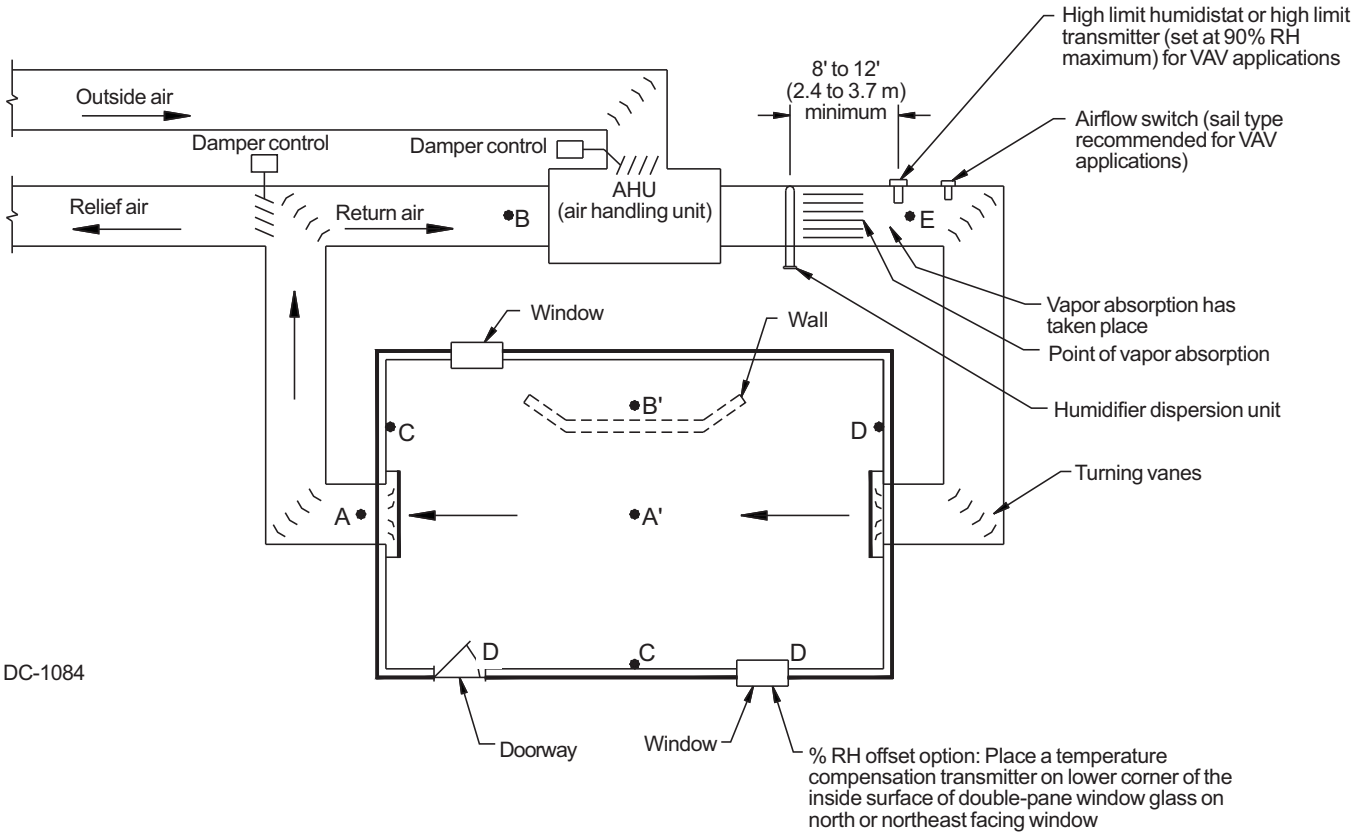
Install a drip tee as shown below when the humidifier is mounted higher than the ULTRA-SORB, when interconnecting hose or piping needs to go over an obstruction, or when interconnecting piping runs are long.

IMPORTANT: Vapor hose must be supported to prevent sagging or low spots.


Dashed lines indicate provided by installer.
90° long sweep or two 45° elbows
Pitch: 1/8"/ft (1%)
Obstruction
Typical evaporative humidifier
Insulate tubing and hard pipe to reduce steam loss
Tubing or pipe drip tee, by installer. DRI-STEEM part numbers for 304 stainless steel inline tees:
• 1½" dia. (DN40): No. 162710
• 2" dia. (DN50): No. 162712
To dispersion device
6" (152 mm) recommended
8" (200 mm) minimum
¾" (DN20)
1" (25 mm) air gap
Funnel or floor drain. Refer to local codes for drain pipe size and maximum temperature requirements.
DC-1166

Installation Guide

Humidistat or sensor placement



IMPORTANT

In most cases, we recommend that you **do not interchange duct and room humidity devices**. Room humidity devices are calibrated with zero or little airflow; whereas, duct humidity devices require air passing across them.

Recommended sensor locations

A This is the ideal sensing location because this placement ensures the best uniform mix of dry and moist air with stable temperature control.

A' This location is acceptable, but the room environment can affect controllability, such as when the sensor is too close to air grilles, registers, or heat radiation from room lighting.

B This location is acceptable because it provides a good uniform mixture of dry and moist air, but if an extended time lag exists between moisture generation and sensing, make sure the control contractor extends the sampling time.

B' This location behind a wall or partition is acceptable for sampling the entire room if the sensor is near an air exhaust return outlet. This location is also typical of sensor placement for sampling a critical area.

C These locations are not acceptable because they may not represent actual overall conditions in the space.

D These locations are not acceptable. Do not place sensors near windows, door passageways, or areas of stagnant airflow.

E This is the best location for a duct high limit humidistat or humidity sensor.

8
Dehumidifier

SUBMITTAL DATA FOR APPROVAL

MODEL: HCD-2250-SBA

PREPARED FOR:
BUFFALO AIR HANDLING

END USER:
BRISTOL MYERS SQUIBB

Customer Purchase Order Number:
E02219-00

Munters Sales Order Number:
21226711

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Section 1 Technical Data

a) Technical Data

b) General Arrangement 87941

Section 2 Wiring

a) Standard Wiring Diagram Legend & Symbols 22602

b) Wiring Diagram K51331

Section 3 Electrical Controls

a) Sequence of Operations K70203

Section 4 Filters

a) 30% Efficiency Data – Farr 30/30 Selection 26983

b) 95% Efficiency Data – Farr Riga-Flo Bulletin I26161

Section 5 Blowers

a) Reactivation Blower Curve

Section 6 Steam Coils

a) Reactivation Steam Coil Data Sheets

b) Heatcraft Steam Coils Catalog 26617

c) Recommended Steam Reactivation Piping Diagram 72164

Section 7 Testing and Certification

a) Quality Management System Certificate

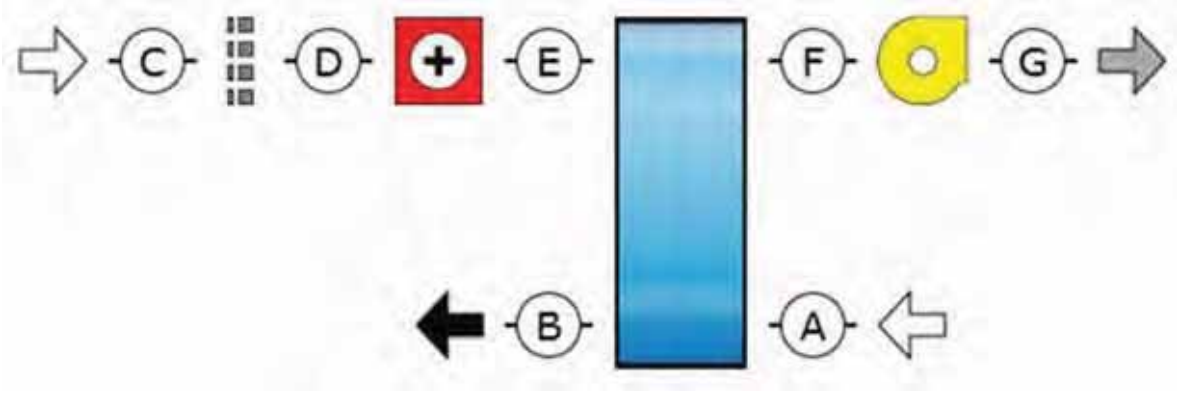
b) Wheel ETL Testing Report 26994

Section 8 Rigging

a) Rigging Instructions 27137

System type	HCD	Prepared by	Greg Ducharme
Plenum size	HCD-2250	Print date	8/5/2013 12:27:22 PM
Name	21226711 - Buffalo Air Handling	Project Name	
Genesys No	G104169-1		

Flow Diagram



Summer

	A	B	C	D	E	F	G
SCFM	1450	1450	480	480	480	480	480
°F	50	106.6	104	104	286.3	115	122.7
gr/lb	53.6	2.71	99	99	99	254.73	254.73
in WC	0	-1.36	0	-1.5	-1.93	-3.6	3.79

System type	HCD	Prepared by	Greg Ducharme
Plenum size	HCD-2250	Print date	8/5/2013 12:27:22 PM
Name	21226711 - Buffalo Air Handling	Project Name	
Genesys No	G104169-1		

Technical Data

System Features

Product Code	HCD-2250-SBA-S
Process Air Outlet	1450 SCFM
Installed Location	Indoor
Electrical Power Source	460/3/60
Full Load Amps	5.9 A
Plenum Size	HCD-2250
Dehumidifier Model	HCD-2250
Reactivation Heater Type	Steam
Desiccant Type	Tigel
Skid Type	None
Process Fan	No

React: Steam Condensate Load	134.5 lb/h
Adsorption Dehumidification	48.3 lb/h

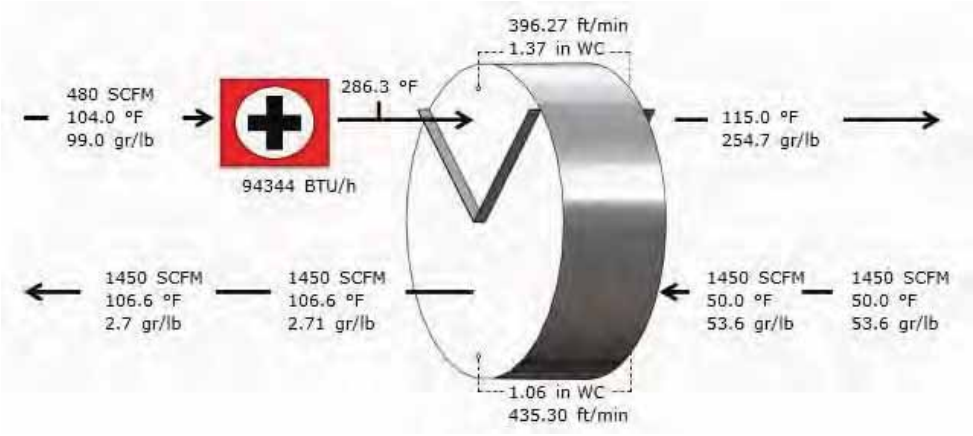
Electrical Options

Dehumidifier Model	HCD-2250
Reactivation Heater Type	Steam
Control System	Siemens S7-200 base
Communications Protocol	None
Electrical Power Source	460/3/60
Control Transformer	500VA
Certification Type	none
Full Load Amps	1.10 A

System type	HCD	Prepared by	Greg Ducharme
Plenum size	HCD-2250	Print date	8/5/2013 12:27:23 PM
Name	21226711 - Buffalo Air Handling	Project Name	
Genesys No	G104169-1		

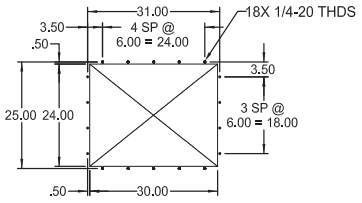
Technical Data

Dehumidifier

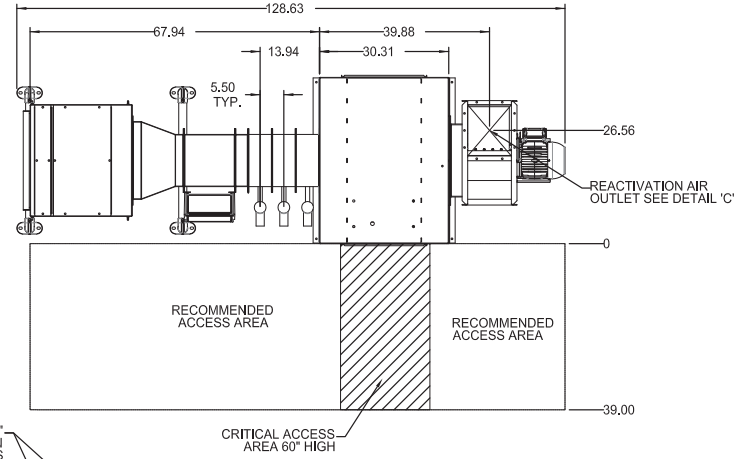


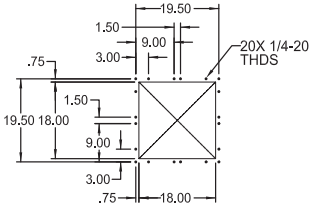
Air Flow Direction	Right to left
Installed Location	Indoor
Electrical Power Source	460/3/60
Dehumidifier Model	HCD-2250
Desiccant Type	Tigel
Bypass Control Type	None
Reactivation Heater Type	Steam
Bypass Section Type	No
Drive Motor Hp	1/100
Actuator Type	None
Number Of Rows	6
Drive Motor Full Load Amps	0.42 A
Steam Temperature	331.38 °F
Rotor Speed	8 rph
Adsorption Dehumidification	48.3 lb/h
React: Steam Condensate Load	134.5 lb/h

Revision	Change note	Rev by	Rev date
0	RELEASED	RAW	8-5-13
1	REVISED REACT FILTER BOX TO 30/65% "HIGH TEMP." AND CHANGED ELECTRICAL ENCLOSURE TO "REMOTE" MOUNT	RAW	9-3-13

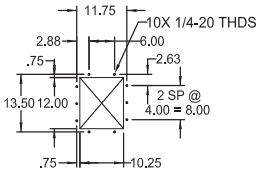


DETAIL 'A'
2250 PROCESS
INLET/OUTLET

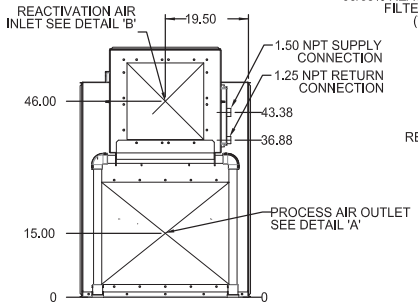


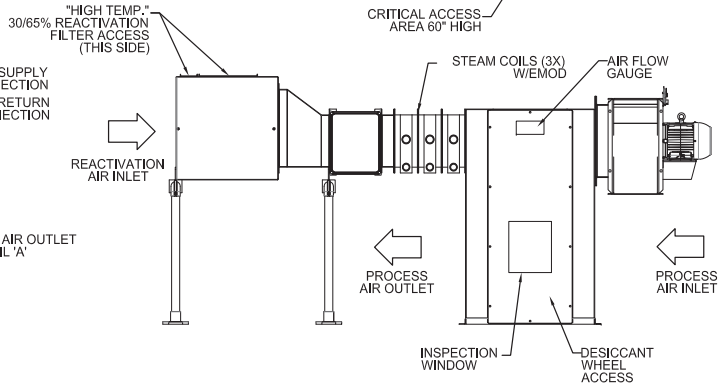


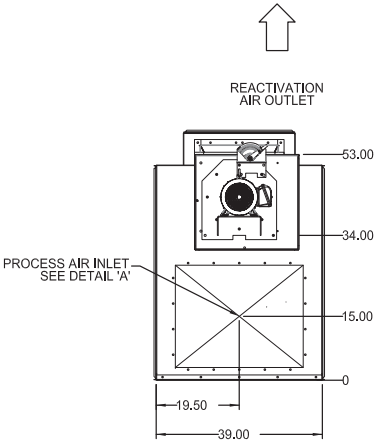
DETAIL 'B'
2250 REACT FILTER INLET



DETAIL 'C'
12-1/4 FAN

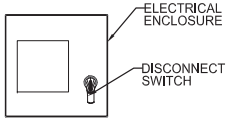






NOTES:

1. CAPACITIES, ENERGY REQUIREMENTS AND FEATURES WILL BE ALTERED TO MATCH APPLICATIONS. CONSULT TECHNICAL DATA SHEET AND MANUAL BEFORE INSTALLING OR OPERATING UNIT.
2. BLOWER(S) ARE PROVIDED WITH DAMPER AND MANUAL LOCKING QUADRANT.
3. UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES
4. ANY ELECTRICAL AND/OR MECHANICAL REASSEMBLY IS THE RESPONSIBILITY OF OTHERS UNLESS PRIOR ARRANGEMENTS HAVE BEEN MADE WITH MUNTERS. THIS INCLUDES DISASSEMBLY THAT WAS NECESSARY TO FACILITATE SHIPPING.
5. SYSTEM SKID IS TO BE FULL PERIMETER SUPPORTED (IF SYSTEM SKID IS PROVIDED BY MUNTERS).
6. SYSTEM IS NOT DESIGNED FOR OPEN ROOF CURB MOUNTING.
7. REFER TO SECTION 110.26 IN THE NEC CODE BOOK FOR CLEARANCES AND REQUIREMENTS TO ELECTRICAL PANELS. THESE REQUIREMENTS MAY IMPACT THE LOCATION OF THE SUPPLIED EQUIPMENT. IT IS THE CUSTOMER'S RESPONSIBILITY TO PLAN THE LOCATION OF THIS EQUIPMENT USING THE REQUIREMENTS SET FORTH IN NEC AND OTHER LOCAL CODES.
8. PROCESS AIR PLENUMS TO BE INTERNALLY ALUMINUM CLADDED.
9. ELECTRICAL ENCLOSURE TO SHIP LOOSE FOR "REMOTE" MOUNTING BY THE CUSTOMER.



SEE NOTE 9

APPROXIMATE WT. = 925 LBS.

PART NO. 87941-01

CUSTOMER: BUFFALO AIR HANDLING

JOB NO.: 21226711-01

Description: GENERAL ARRANGEMENT HCD-2250-SBA-S

Tolerances, if not indicated, according to: See MUNTERS Doc.No. 160-010266-001

Sheet: 1/1

Revision: 1

Munters

Design by: RAW DATE: 8-2-13

Design. ckd: GDD DATE: 8/5/2013

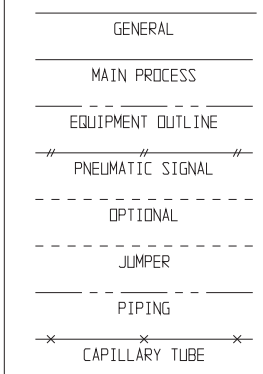
Drawing / Part No: 87941

STANDARD DEVICE AND COMPONENT IDENTIFICATION AND PIPING IDENTIFICATION

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
AI	ANALOG INPUT	ENC	ENCLOSURE	MTR	MOTOR	RES	RESISTOR
AO	ANALOG OUTPUT	EPL	ELECTRICAL PARTS LIST	NC	NORMALLY CLOSED	RG	REGULATOR
AFS	AIR FLOW SWITCH	EPR	EVAPORATOR PRESSURE REGULATING VALVE	NO	NORMALLY OPEN	RSS	ROTARY SWITCH
AP	ALARM POINT VALUE	EPS	ENCLOSURE PROTECTION SYSTEM	OLR	OVERLOAD RELAY	RTD	RESISTIVE TEMPERATURE DETECTOR
ATM	ATMOSPHERE	ES	EMERGENCY STOP	OOF	OPEN ON FALL	SD	SMOKE DETECTOR
BU	BULB	ETM	ELAPSED TIME METER	OOR	OPEN ON RISE	SEN	SENSOR
C	CLOSED	FB	FUSE BLOCK	P/I	PNEUMATIC TO CURRENT TRANSDUCER	SOL	SOLENOID
CAP	CAPACITOR	FIT	FLOW INDICATING TRANSMITTER	P/P	PNEUMATIC TO PNEUMATIC POSITIONER	SP	SETPOINT VALUE
CB	CIRCUIT BREAKER	FLS	FLOW SWITCH	P/S	PRESSURE SWITCH	SS	SELECTOR SWITCH
CCR	CIRCULAR CHART RECORDER	FO	FAIL OPEN	PB	PUSHBUTTON	SSP	SOLID STATE POWER CONTROLLER
CO	CONDENSING UNIT	FSV	FLAME SAFETY CONTROLLER	PCB	PRINTED CIRCUIT BOARD	SV	SOLENOID VALVE
CF	CARTRIDGE FILTER	FU	FUSE	PD	PRESSURE DIFFERENTIAL	SW	SWITCH
CMDP	CHILLER MIRROR DEW POINT	GFCI	GROUND FAULT CIRCUIT INTERRUPTER	PDI	PRESSURE DIFFERENTIAL INDICATOR	TB	TERMINAL BLOCK
CN	CONTACTOR	GMV	GAS MODULATING VALVE	PDIS	PRESSURE DIFFERENTIAL INDICATING SWITCH	T/C	THERMOCOUPLE
COR	CLOSE ON RISE	GND	GROUND	PDIT	PRESS. DIFF. INDICATING TRANSMITTER	TC	TEMPERATURE CONTROLLER
CR	CONTROL RELAY	GPS	GAS PROVING SYSTEM	PDITS	PRESS. DIFF. INDICATING TRANSMITTER & SWITCH	TE	TEMPERATURE ELEMENT
CV	CONTROL VALVE	H	HIGH	PDS	PRESSURE DIFFERENTIAL SWITCH	TG	TEMPERATURE GAUGE
D/H	DEHUMIDIFIER	HGV	HOT GAS VALVE	PDT	PRESSURE DIFFERENTIAL TRANSMITTER	TR	TIMING RELAY
DA	DAMPER ACTUATOR	HGSV	HOT GAS VALVE & SOLENOID	PDTS	PRESS. DIFF. TRANSMITTER & SWITCH	TS	TEMPERATURE SWITCH
DFG	DIRECT FIRE GAS	HRN	HORN	PG	PRESSURE GAUGE	TT	TEMPERATURE TRANSMITTER
DI	DIGITAL INPUT	HT	HUMIDITY TRANSMITTER	PL	PLUG	T	TRANSFORMER
DO	DIGITAL OUTPUT	HTR	ELECTRIC HEATER	PLC	PROGRAMMABLE LOGIC CONTROLLER	VA	VALVE ACTUATOR
DIS	FUSED DISCONNECT	HUM	HUMIDIFIER	PM	PHASE LINE MONITOR	VFD	VARIABLE FREQUENCY DRIVE
DP	DEWPOINT TRANSMITTER/DISPLAY	I/P	CURRENT TO PNEUMATIC TRANSDUCER	PNL	PANEL	VIB	VIBRATION SENSOR/ACCELEROMETER
DPG	DIFFERENTIAL PRESSURE GAUGE	IC	IGNITION CONTROLLER	PRS	PROXIMITY SWITCH	VM	VENT MOTOR
DPS	DIFFERENTIAL PRESSURE SWITCH	L	LOW	PS	POWER SUPPLY	VT	VENT
DPT	DEWPOINT TRANSMITTER	LS	LIMIT SWITCH	PSH	PRESSURE SWITCH HIGH	VVA	VARIABLE VANE ACTUATOR
DS	DISCONNECT	LLSV	LIQUID LINE SOLENOID VALVE	PSI	POUNDS PER SQUARE INCH	ZS	POSITION SWITCH
DSP	DISPLAY	LT	LIGHT	PSL	PRESSURE SWITCH LOW	ZSC	POSITION SWITCH CLOSED
E/P	ELECTRIC TO PNEUMATIC SOLENOID VALVE	MGV	MAIN GAS VALVE	PT	PRESSURE TRANSMITTER	ZSO	POSITION SWITCH OPEN
		MIT	MOISTURE INDICATOR TRANSMITTER	R/C	RESISTOR CAPACITOR		
		MS	MOTOR STARTER	RC	RECEIVER CONTROLLER		
		MT	MOISTURE TRANSMITTER	RCP	RECEPTACLE		

Revisions					
Rev	Description	Date	Dft	Chk	App
1	ADDED SUPPLY AIR PRESSURE NUMBER	1/16/97	DMR	KPW	KPW
2	ADDED IDENTIFICATIONS, CAPILARY TUBE LINE SYMBOL, & 3 LETTER WIRE ABRV.	3/6/97	DMR	KPW	KPW
3	ADDED PIPING IDENTIFICATION	8/25/97	DMR	KPW	KPW
4	ADDED RFQ, PV-- & SSR--	5/15/97	CJT	KPW	KPW
5	ADDED- (AMB)-AMBER COLOR	5/15/97	RRM	KPW	KPW
6	ADDED SYBOLS MIT THRU POS	5/03/01	TJM	KPW	KPW
7	ADDED VIB SYMBOL	8/21/03	CAG	KPW	CAG
8	NEW SYMBOLS ON SHEET 2 ADDED	9/04/12	YD	KPL	CAG

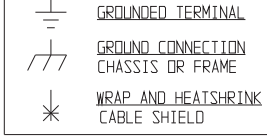
LINE SYMBOLS



COLOR CODE ABBREVIATIONS

BLK - BLACK	BLU - BLUE
BRN - BROWN	GRY - GRAY
RED - RED	WHT - WHITE
ORG - ORANGE	CLR - CLEAR
YLW - YELLOW	VLT - VIOLET
GRN - GREEN	

GENERAL SYMBOLS



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		Date
Job No.	STD	
Customer		
Dr.By.	TAB	10/15/96
Ck.By	KPW	10/16/96
Aprv.By.	KPW	10/16/96

Munters Cargocaire
79 Monroe St. Amesbury, Ma 01913
TEL 508-388-0600 FAX 508-388-0292

STANDARD WIRING, PROCESS & INSTRUMENTATION LEGENDS & SYMBOLS IDENTIFICATION

SCALE	SHEET	SIZE		REV
NTS	1 of 2	B	22602	8

SYMBOL IDENTIFICATION

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	LOCALLY MOUNTED	CWR	CHILLED WATER RETURN		PRESSURE RELIEF REGULATOR
	PANEL MOUNTED	CWS	CHILLED WATER SUPPLY		MOTOR ACTUATED VALVE
	INSIDE PANEL MOUNTED	GLR	GLYCOL RETURN		GLOBE VALVE
	ALARM	GLS	GLYCOL SUPPLY		BACK DRAFT DAMPER
A	AMBER INDICATOR LIGHT	HWR	HOT WATER RETURN		ROUND OR RECTANGULAR DAMPER
B	BLUE INDICATOR LIGHT	HWS	HOT WATER SUPPLY		ADJUSTABLE GAS COCK
G	GREEN INDICATOR LIGHT	NG	NATURAL GAS		MANUAL OPERATION
R	RED INDICATOR LIGHT	RFG	REFRIGERATION HOT GAS LINE		STRAINER
W	WHITE INDICATOR LIGHT	RFL	REFRIGERATION LIQUID LINE		LEAK TESTER
S ##	SUPPLY AIR PRESSURE NUMBER	RFS	REFRIGERATION SUCTION LINE		FILTER/REGULATOR
I	CONTROLS INTERLOCK	SLP	STEAM LINE PRESSURE		EXPANSION/FLEXIBLE PIPE
O	PROGRAMMABLE LOGIC CONTROLLER OUTPUT	SCR	SOLID STATE CONTROL RELAY		FILTER
	ANALOG OR DIGITAL INPUT OR OUTPUT TO OR FROM INSIDE PANEL MOUNTED PLC	STM	STEAM		FILTER, IN LINE
IA	INSTRUMENT AIR		1/2" NPT PORT		FLOW SWITCH
CA	COMPRESSED AIR		FLANGED CONNECTION		THERMAL EXPANSION VALVE
WTR	WATER		EXPANSION/FLEXIBLE JOINT		HUMIDIFIER
AA	AMBIENT AIR		GENERAL VALVE		ELECTRICAL HEATER
LP	LIQUID PROPANE		MANUAL VALVE W/TEST PORT		COIL
FO	FUEL OIL		PRESSURE REGULATOR		INDIRECT FIRED GAS BURNER
CA	COMBUSTION AIR		PRESSURE REGULATOR (SELF CONTAINED)		DIRECT FIRED GAS HEATER
CON	CONDENSATION		3-WAY VALVE		WEATHER HOOD/LOUVER

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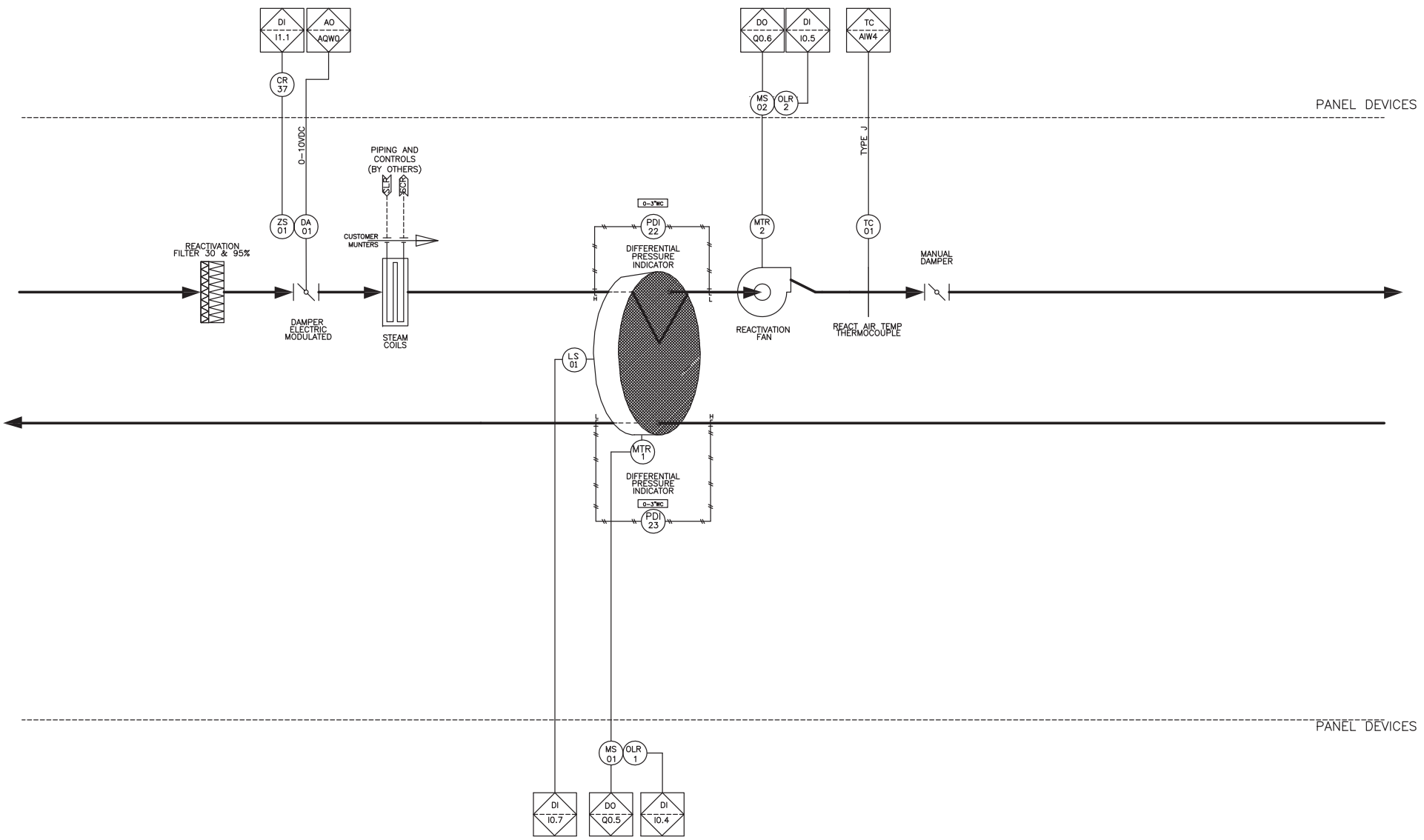
NTS	2 of 2	B	22602	8



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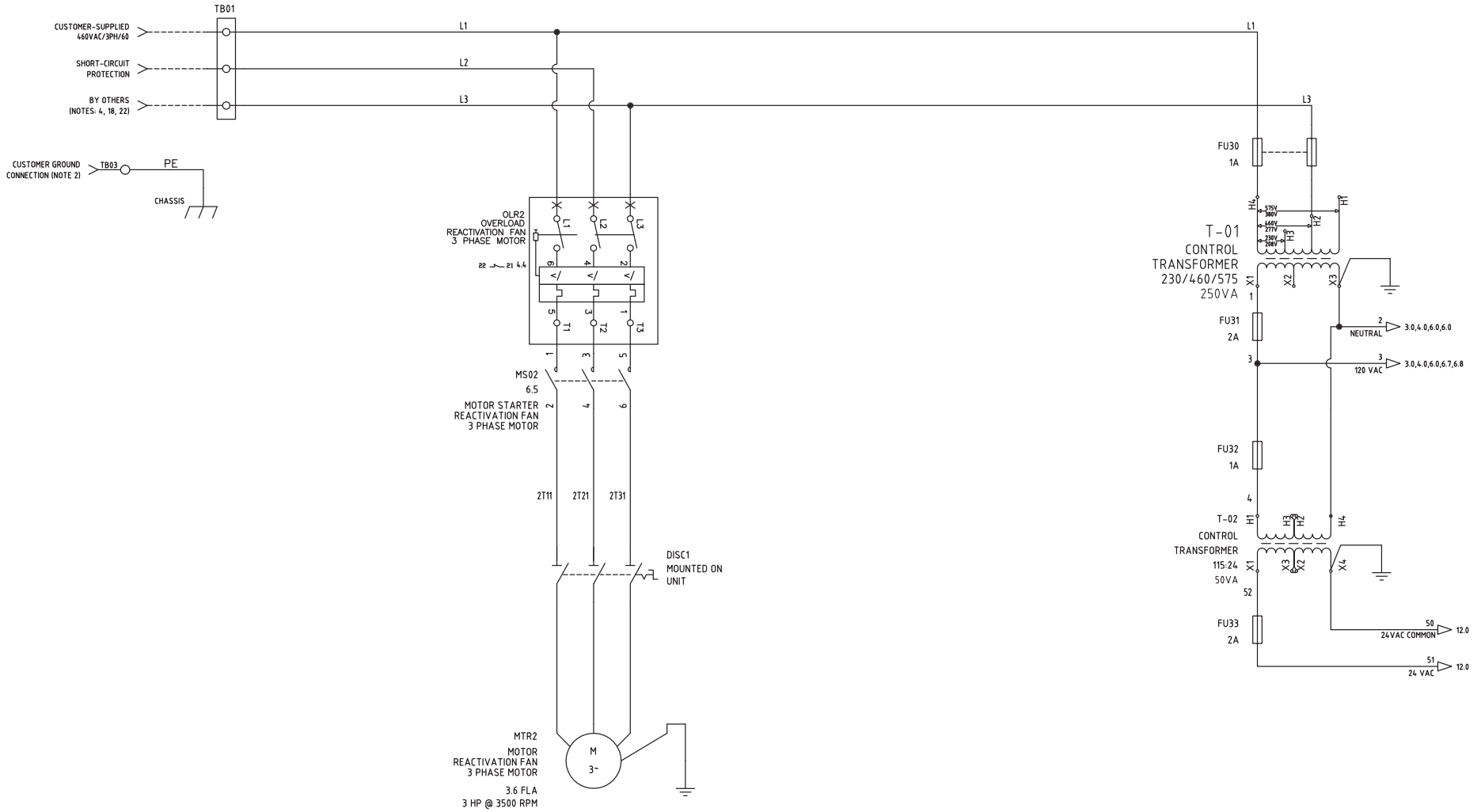
DRAWING DESCRIPTION
HCD/ICA STANDARD SCHEMATICS,STEAM HEAT W/O F&BP

FOR SEQUENCE OF OPERATION, REFER TO K70203

WIRING DIAGRAM HCD-2250-SBA-S

Dr. By	Ck. By	Aprv. By	DATE	Job No.	Customer	SHEET	SIZE		REV
DSL	RDS	RDS	8/1/13	21226711-01	BUFFALO AIR HANDLING	1 OF 14	B	K51331	A



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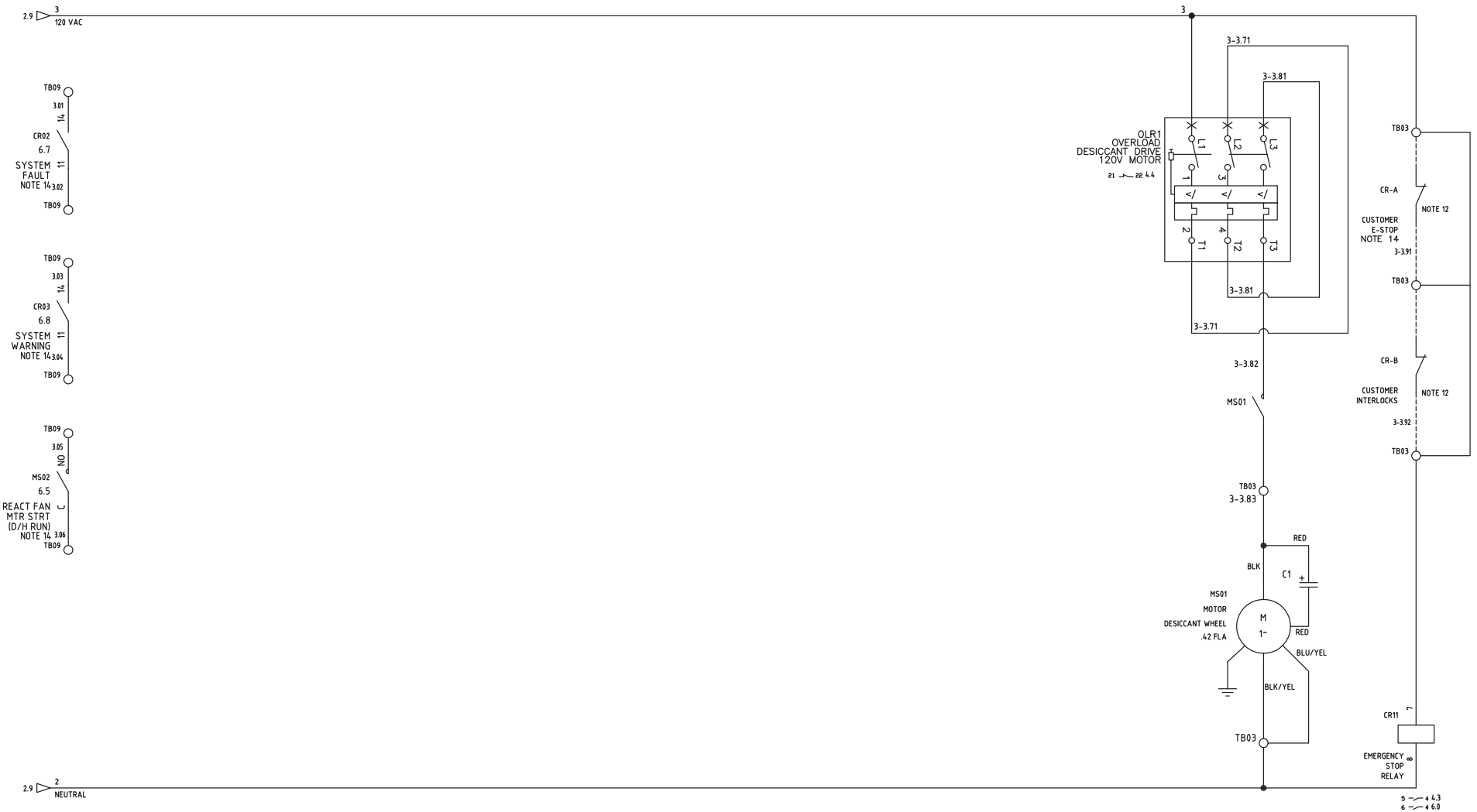
Dr. By	Ck. By	Aprv. By	DATE	Job No.	Customer	SHEET	SIZE		REV
DSL	RDS	RDS	8/1/13	21226711-01	BUFFALO AIR HANDLING	2 OF 14	B	K51331	A



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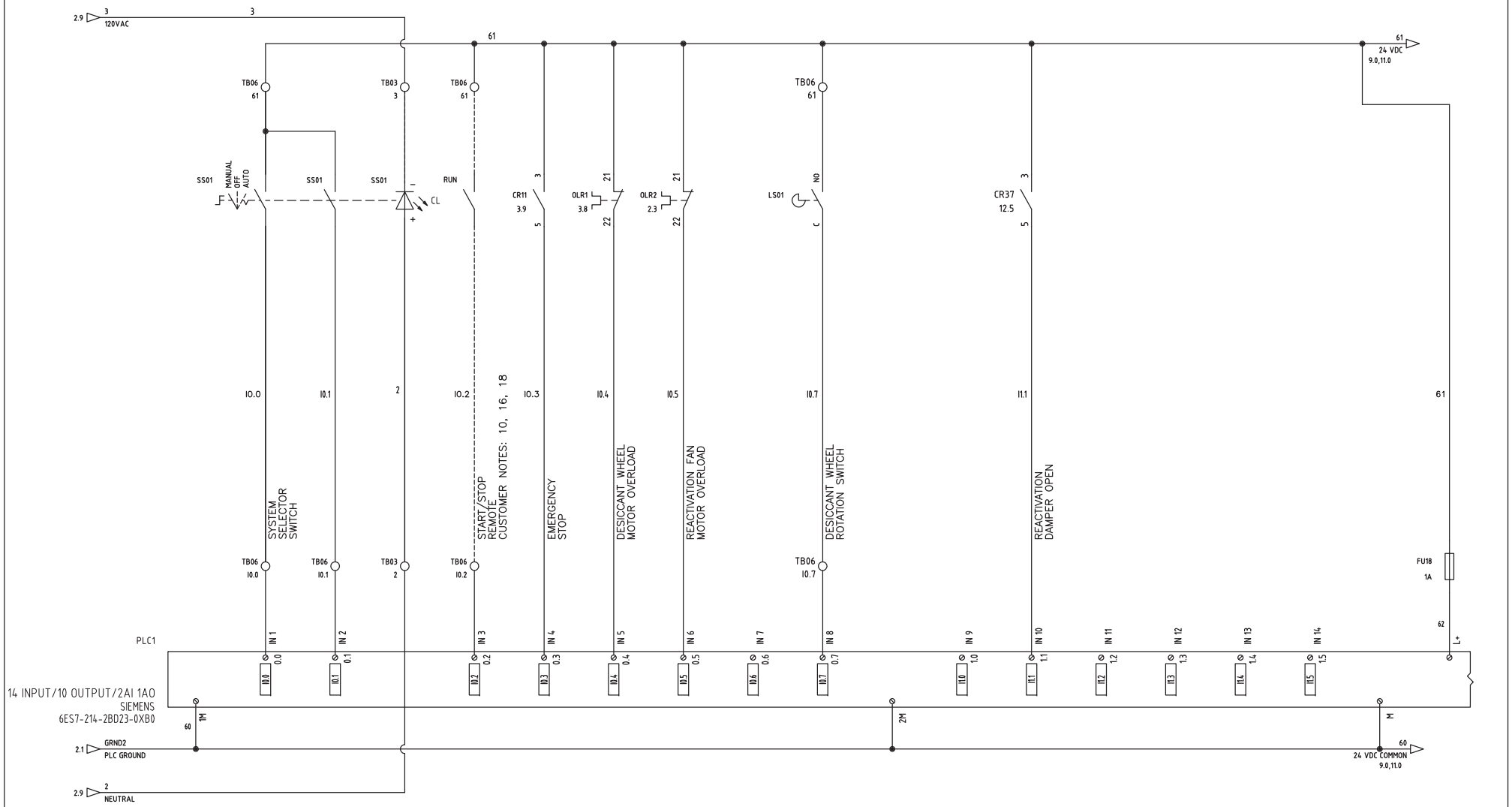
FOR SEQUENCE OF OPERATION, REFER TO K70203

WIRING DIAGRAM HCD-2250-SBA-S

Dr. By	Ck. By	Aprv. By	DATE	Job No.	Customer	SHEET	SIZE		REV
DSL	RDS	RDS	8/1/13	21226711-01	BUFFALO AIR HANDLING	3 OF 14	B	K51331	A



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FOR SEQUENCE OF OPERATION, REFER TO K70203

WIRING DIAGRAM HCD-2250-SBA-S

Dr. By	Ck. By	Aprv. By	DATE	Job No.	Customer	SHEET	SIZE		REV
DSL	RDS	RDS	8/1/13	21226711-01	BUFFALO AIR HANDLING	4 OF 14	B	K51331	A

5.0	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9

SPARE SHEET

Munters
79 Monroe St. Amesbury, Ma 01913
TEL 800-843-5360 FAX 978-241-1214

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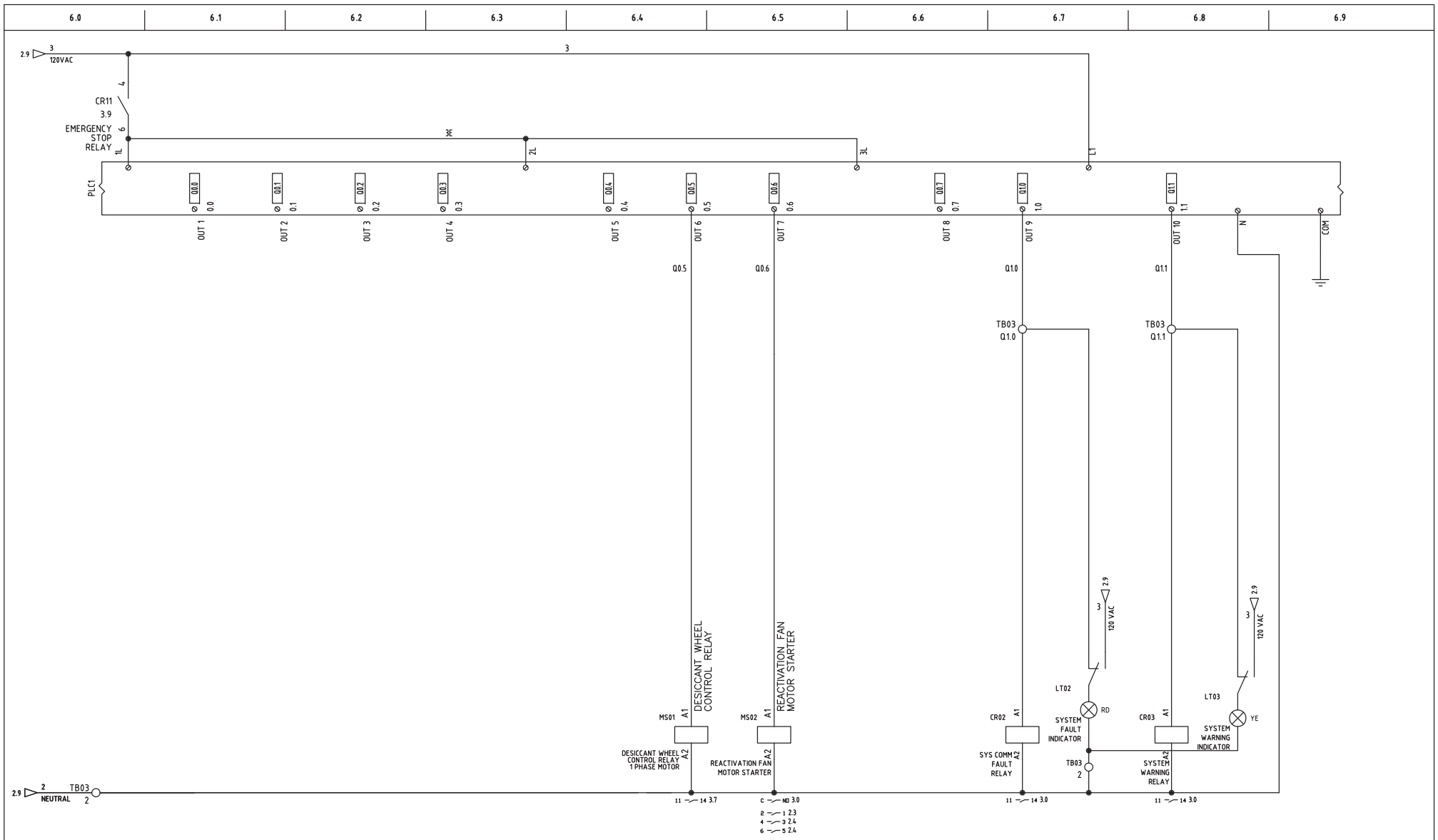
DRAWING DESCRIPTION
HCD/ICA STANDARD SCHEMATICS,STEAM HEAT W/O F&BP

FOR SEQUENCE OF OPERATION, REFER TO K70203

WIRING DIAGRAM HCD-2250-SBA-S

Dr. By	Ck. By	Aprv. By	DATE	Job No.	Customer	SHEET	SIZE		REV
DSL	RDS	RDS	8/1/13	21226711-01	BUFFALO AIR HANDLING	5 OF 14	B	K51331	A



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FOR SEQUENCE OF OPERATION, REFER TO K70203

WIRING DIAGRAM HCD-2250-SBA-S

Dr. By	Ck. By	Aprv. By	DATE	Job No.	Customer	SHEET	SIZE		REV
DSL	RDS	RDS	8/1/13	21226711-01	BUFFALO AIR HANDLING	6 OF 14	B	K51331	A

7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9

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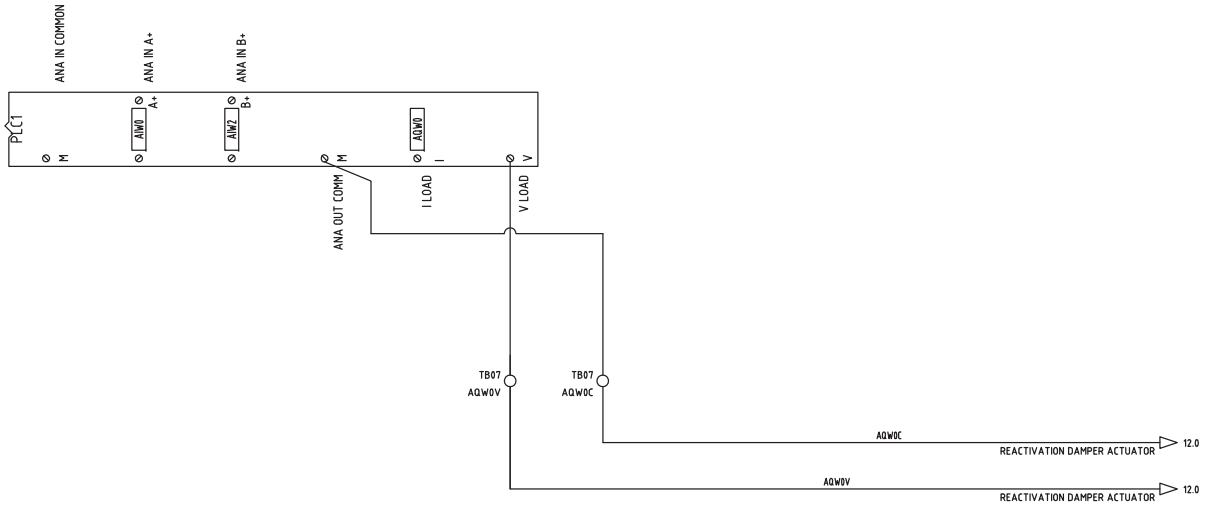
Dr. By	Ck. By	Aprv. By	DATE	Job No.	Customer	SHEET	SIZE		REV
DSL	RDS	RDS	8/1/13	21226711-01	BUFFALO AIR HANDLING	7 OF 14	B	K51331	A

8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8	8.9



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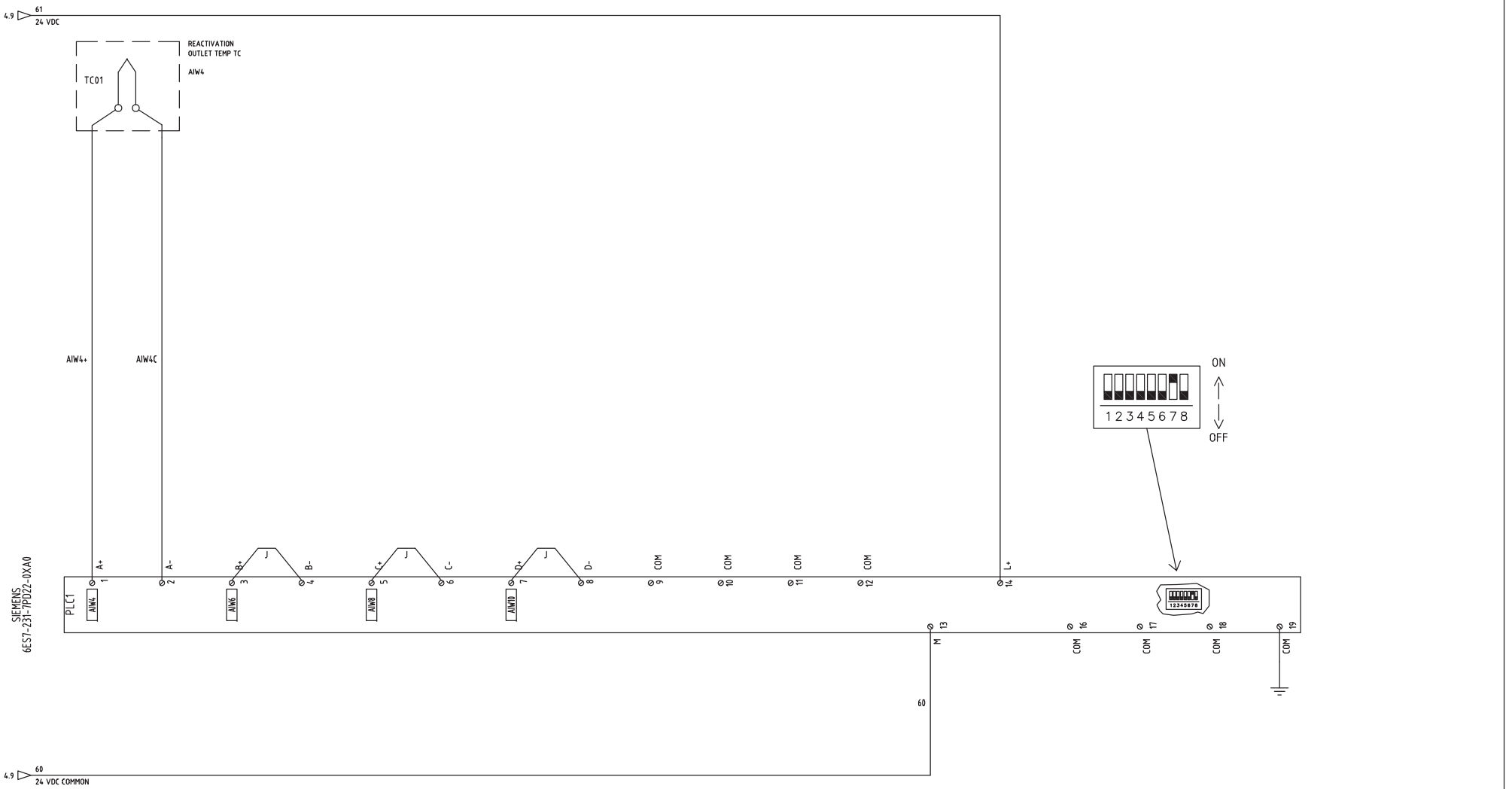
Dr. By	Ck. By	Aprv. By	DATE	Job No.	Customer	SHEET	SIZE		REV
DSL	RDS	RDS	8/1/13	21226711-01	BUFFALO AIR HANDLING	8 OF 14	B	K51331	A



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WIRING DIAGRAM HCD-2250-SBA-S

Dr. By	Ck. By	Aprv. By	DATE	Job No.	Customer	SHEET	SIZE		REV
DSL	RDS	RDS	8/1/13	21226711-01	BUFFALO AIR HANDLING	9 OF 14	B	K51331	A

10.0	10.1	10.2	10.3	10.4	10.5	10.6	10.7	10.8	10.9

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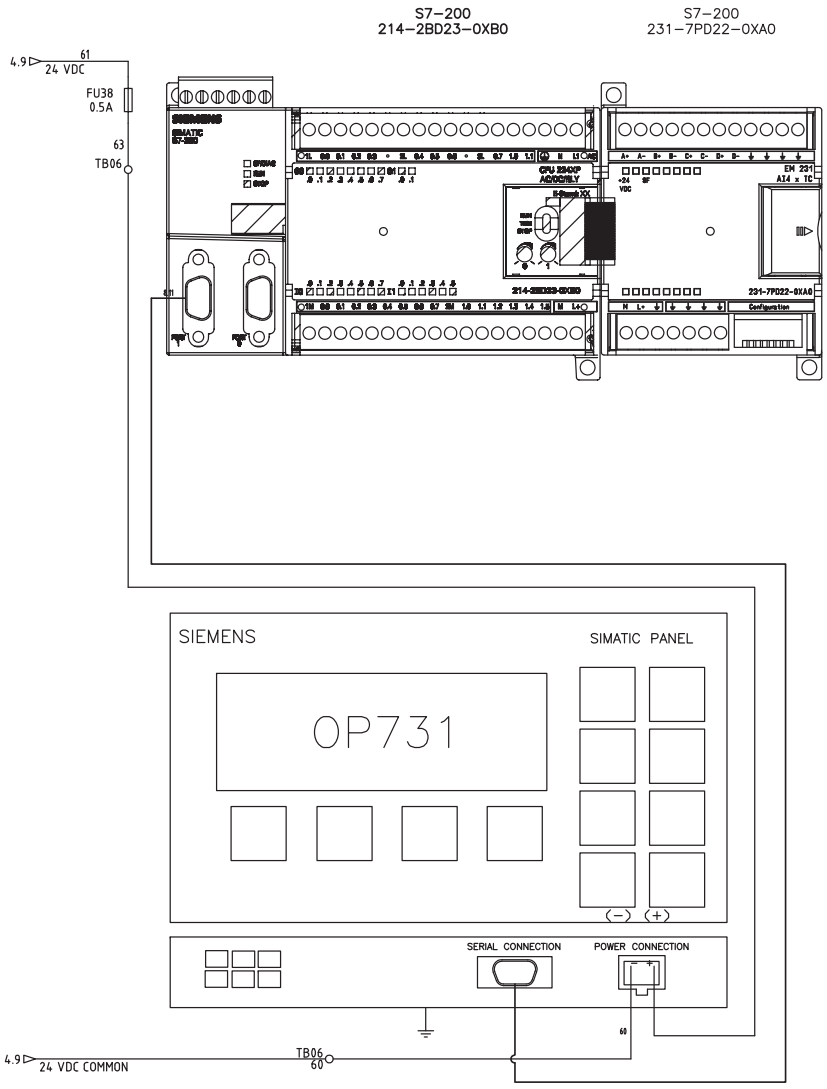
WIRING DIAGRAM HCD-2250-SBA-S

Dr. By	Ck. By	Aprv. By	DATE	Job No.	Customer	SHEET	SIZE		REV
DSL	RDS	RDS	8/1/13	21226711-01	BUFFALO AIR HANDLING	10 OF 14	B	K51331	A

11.0	11.1	11.2	11.3	11.4	11.5	11.6	11.7	11.8	11.9



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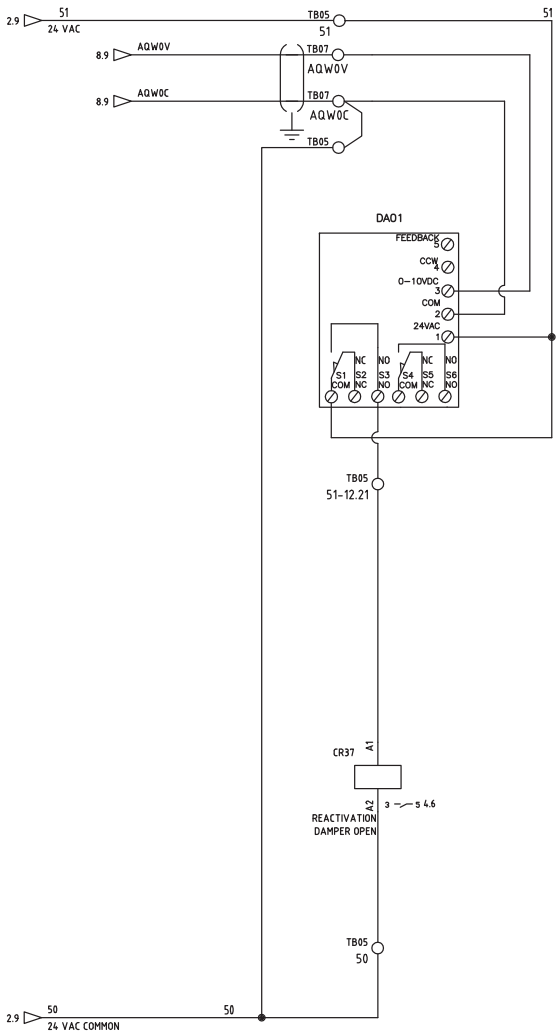
HCD/ICA STANDARD SCHEMATICS,STEAM HEAT W/O F&BP

FOR SEQUENCE OF OPERATION, REFER TO K70203

WIRING DIAGRAM HCD–2250–SBA–S

Dr. By	Ck. By	Aprv. By	DATE	Job No.	Customer	SHEET	SIZE		REV
DSL	RDS	RDS	8/1/13	21226711–01	BUFFALO AIR HANDLING	1 1 OF 1 4	B	K51331	A

12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9



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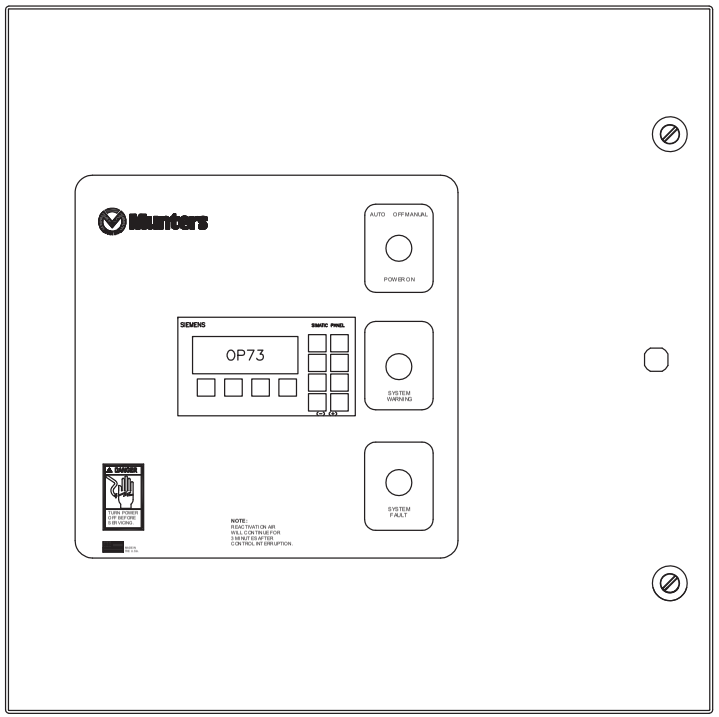
HCD/ICA STANDARD SCHEMATICS,STEAM HEAT W/O F&BP

FOR SEQUENCE OF OPERATION, REFER TO K70203

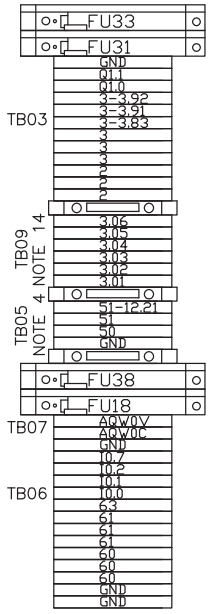
WIRING DIAGRAM HCD-2250-SBA-S

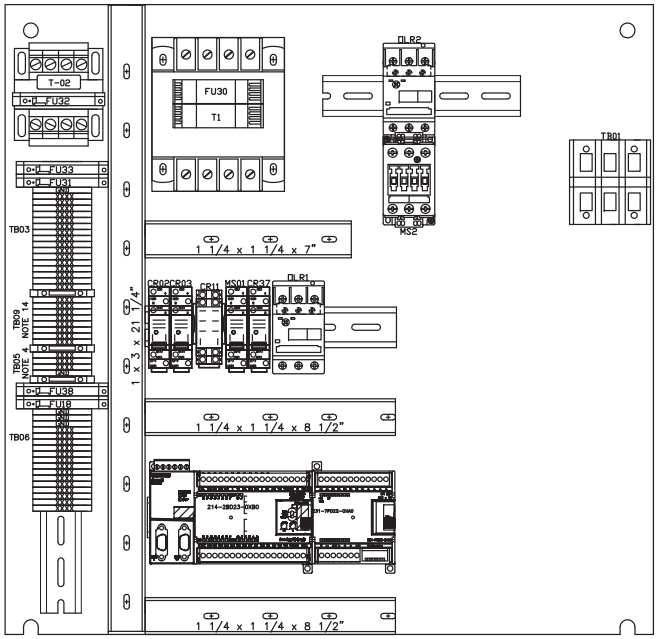
Dr. By	Ck. By	Aprv. By	DATE	Job No.	Customer	SHEET	SIZE		REV
DSL	RDS	RDS	8/1/13	21226711-01	BUFFALO AIR HANDLING	12 OF 14	B	K51331	A

13.0	13.1	13.2	13.3	13.4	13.5	13.6	13.7	13.8	13.9



CONTROL ENCLOSURE 24 X 24 X 8 (NEMA 4)
(ENCL0)





PANEL LAYOUT
(PNL0)

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FOR SEQUENCE OF OPERATION, REFER TO K70203

WIRING DIAGRAM HCD-2250-SBA-S

Dr. By	Ck. By	Aprv. By	DATE	Job No.	Customer	SHEET	SIZE		REV
DSL	RDS	RDS	8/1/13	21226711-01	BUFFALO AIR HANDLING	13 OF 14	B	K51331	A

14.0	14.1	14.2	14.3	14.4	14.5	14.6	14.7	14.8	14.9

	REVISIONS				
A	SUBMITTAL TO CUSTOMER	DSL	RDS	RDS	8/1/13
REV	DESCRIPTION	DRW	CHK	APR	DATE

NOTES:

1. REVIEW OPERATING & MAINTENANCE MANUAL BEFORE ENERGIZING EQUIPMENT.
2. CUSTOMER–SUPPLIED EARTH GROUND TO BE TERMINATED AT KP LUG OR GROUNDING STRIP PROVIDED.
3. PROTECTIVE DEVICES HAVE BEEN PRESET AND/OR SELECTED AND ARE RECORDED AT FACTORY PER SPECIFICATION 22096/22576.
4. OPTIONAL EQUIPMENT.
5. N/A.
6. ALL WIRING SHOWN WITH SOLID LINES IS INSTALLED AT THE FACTORY.
7. SEE ELECTRICAL PARTS LIST FOR COMPONENT SPECIFICATION.
8. NO = NORMALLY OPEN, OOR = OPEN ON RISE,
   NC = NORMALLY CLOSED, OOF = OPEN ON FALL.
10. INTERLOCK WIRING FOR AUTOMATIC START/STOP IS NOT BY MUNTERS.
11. USE SHIELDED CABLE, NOT LESS THAN #18 AWG.
12. REMOVE JUMPERS WHEN INTERLOCKING SAFETIES.
13. ELECTRICAL WIRE SIZING DATA: STANDARD: A72001/CANADIAN: A72011
14. AUXILIARY INTERLOCK IS PROVIDED FOR CUSTOMER INTERLOCKING.
15. SHIPPED REMOTE FROM FACTORY, INSTALLED BY OTHERS.
16. CUSTOMER CONTROLS.
17. N/A.
18. FIELD WIRED, BY INSTALLER.
19. TRANSFORMER VOLTAGES SHOWN COVER ALL STANDARD 50/60Hz APPLICATIONS.
    THE ACTUAL TRANSFORMER USED IS DETERMINED BY THE POWER SOURCE.
20. DASHED LINES ARE CUSTOMER WIRED FOR INTERCONNECT.
21. INTERLOCK PROVIDED FOR OPTIONAL HUMIDISTAT OR LIMIT SWITCH ON.
22. MAIN POWER DISCONNECT DEVICE NOT SUPPLIED BY MUNTERS AS STANDARD AND MUST BE PROVIDED BY CUSTOMER. FUSED DISCONNECT OR CIRCUIT BREAKER AVAILABLE AS OPTIONAL EQUIPMENT.
23. ACTUAL MOTOR FLA RATING REFER TO UL TABLE.
24. MOTOR OVERLOAD PROTECTION RATING IS BASED ON ACTUAL MOTOR NAMEPLATE FLA.
25. OPTIONAL SAFETIES FOR "INDOOR" INDIRECT GAS REACTIVATION ONLY. REMOVE JUMPER WHEN INSTALLING POWER VENTOR SAFETIES.
26. N/A.
27. N/A.
28. N/A.

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DRAWING DESCRIPTION
HCD/ICA STANDARD SCHEMATICS,ELECTRIC HEAT W/O F&BP

FOR SEQUENCE OF OPERATION, REFER TO K70203

WIRING DIAGRAM HCD–2250–SBA–S

Dr. By	Ck. By	Aprv. By	DATE	Job No.	Customer	SHEET	SIZE		REV
DSL	RDS	RDS	8/1/13	21226711-01	BUFFALO AIR HANDLING	14 OF 14	B	K51331	A

STANDARD SEQUENCE of OPERATION
HCD-1125 thru 9000-SA / ICA-0500 thru 1500

NOTE: Before servicing the dehumidifier, refer to the "OPERATION AND MAINTENANCE MANUAL" provided with the dehumidifier

1.0 CUSTOMER INTERFACE

1.1 Sequence is as follows:

1.1.1 "AUTO / OFF / MANUAL" selector switch is provided for starting the system in the Auto mode by interfacing with the customer supplied equipment. A contact closure via the "ON/OFF" selector switch between TB06#61 and TB06#I0.1 will let the system start in auto mode. The MANUAL mode does not require the dry contact closure input to enable the system to start. The selector switch has an integral light and will stay illuminated at all times to indicate the equipment has power.

2.0 AUXILIARY DRY CONTACTS

2.1 Operational System States

2.1.1 SYSTEM FAULT: Auxiliary dry contacts of CR02 are provided for customer interlocking and shall close whenever the dehumidifier goes into any fault as described in Section 6.0.

2.1.2 SYSTEM RUN (MASTER CONTROL RELAY): Auxiliary dry contacts of MS03 are provided for customer interlocking and shall close whenever the process blower is in operation.

2.1.3 SYSTEM WARNING: Auxiliary dry contacts of CR03 are provided for customer interlocking and shall close whenever the dehumidifier goes into a warning condition.

2.1.4 D/H RUN: Auxiliary dry contacts of MS02 are provided for customer interlocking and shall close whenever the dehumidifier is in operation.

3.0 START-UP

3.1 Main Power Initialization Sequence:

3.1.1 Energize the main power to the equipment by supplying correct voltage to either a customer connection directly to the main TB01 terminal block or by using the system's main disconnect DS1. (The selector switch will illuminate indicating the equipment is energized)

3.1.2 The equipment's high voltage is supplied to all motor starters and the control transformer(s). The control voltage (115V/1Ø/60Hz) is now being supplied to the control circuits.

3.1.3 The HMI LCD, located on or in (visible through the door) the Main control enclosure is energized and will display the "System Screen" (Figure 1.0).

3.1.4 There is a 10 sec delay in the equipment startup of the system once power is activated via the selector switch.

3.1 Startup:

3.1.1 Normal startup operation shall occur once the main selector switch (SS01) is placed in the MANUAL or in AUTO position with a customer-supplied auxiliary interlock (dry-contact) closed between TB06#61 and TB06#I0.2

3.3 SHUTDOWN

3.3.1 Normal Shutdown

A Shutdown shall occur with the following.

3.3.1.1 Selector Switch (SS01) is maintained in the OFF position

3.3.1.2 Selector Switch (SS01) is maintained in Auto position with a contact opening across TB06 # 61 and TB06 # I0.2.

3.3.1.3 A fault has occurred.

3.3.2 Sequence of Normal Shutdown

3.3.2.1 The reactivation control Proportional Control Loop, and associated fault circuits are de-energized.

3.3.2.2 The process control loops are de-energized (section 6.0).

3.3.2.3 A purge timer in the (PLC1) is a delay time with a fixed on time of three (3) minutes. This allows the air to continue to cool the desiccant wheel. When the timer has completed its count cycle, the desiccant wheel drive motor (MTR1), the reactivation blower motor (MTR2), and supply blower motor (MTR3) are all de-energized.

IMPORTANT: Do not shut down unit by de-energizing main power prior to completion of purge cycle. (Wait for “PURGING” to change to either “STANDBY” or “READY” before de-energizing main power.)

4.0 FAULTS & WARNINGS

ESC or Help button may be pressed twice quickly to exit back to the system screen at any time during screen navigation.

4.1 Alarm Indication

4.1.1 Fault and warning indication is seen in two possible manners on the equipment's control enclosure. The HMI display and fault warning lights. The HMI will display the blinking triangle with exclamation point and the fault message on the Alarm screen (figure 1.4).

4.1.2 A fault results in the Red Light (LT02) remaining illuminated constantly.

4.2 List of System and DH Faults

4.2.1 *FAULT* - D/H WHEEL MOTOR FAULT

4.2.1.1 If the desiccant drive motor starter/protector (MSP1) trips the system is faulted.

4.2.1.2 The system will go into the shutdown sequence as described in Section 4.0, and the system auxiliary dry contacts close in sequence (described in Section 2.0), also process blower will purge.

4.2.1.3 The dehumidifier will be held in the 'Fault' condition by (PLC1). To restart the dehumidifier clear the alarm pressing the acknowledge ACK on the HMI, reset the overload, and go to the ALARM screen and press the F4 RESET key this resets the PLC. To restart the system, the selector switch (SS01) must be moved to the "OFF" position, then move (SS01) back to the "AUTO" or "MANUAL" position.

4.2.2 *FAULT* - REACTIVATION MOTOR FAULT

4.2.2.1 If the reactivation blower motor starter/protector (MSP2) trips the system is faulted.

4.2.2.2 The dehumidifier goes into the shutdown sequence, as described in Section 4.0, and the system auxiliary dry contacts sequence as described in Section 2.0 The dehumidifier will be held in the 'Fault' condition by (PLC1). To restart the dehumidifier clear the alarm pressing the acknowledge ACK on the HMI, reset the overload, and go to the ALARM screen and press the F4 RESET key this resets the PLC. To restart the system, the selector switch (SS01) must be moved to the "OFF" position, then move (SS01) back to the "AUTO" or "MANUAL" position.

4.2.3 *FAULT* - SUPPLY BLOWER MOTOR FAULT

4.2.3.1 If the supply blower motor starter/protector (MSP3) trips or the customer-supplied variable frequency drive (VFD) goes into a Fault, the system is faulted.

4.2.3.2 The system will go into the shutdown sequence (described in Section 4.0), and the system auxiliary dry contacts close in sequence (described in Section 2.0).

4.2.3.3 The dehumidifier will be held in the 'Fault' condition by (PLC1). To restart the dehumidifier clear the alarm pressing the acknowledge ACK on the HMI, reset the overload, and go to the ALARM screen and press the F4 RESET key this resets the PLC. To restart the system, the selector switch (SS01) must be moved to the "OFF" position, then move (SS01) back to the "AUTO" or "MANUAL" position.

4.2.4 *FAULT* - DEHUMIDIFIER WHEEL ROTATION

4.2.4.1 Limit switch (LS01) is wired normally closed, and is located inside the dehumidifier wheel compartment next to desiccant wheel. As the wheel turns, a cam fastened to the wheel housing opens this limit switch.

4.2.4.2 If limit switch (LS01) is not opened once every 600 seconds, a timer in (PLC1) times out the system is faulted.

4.2.4.3 The system will go into the shutdown sequence (described in Section 4.0), and the system auxiliary dry contacts close in sequence (described in Section 2.0).

4.2.4.4 The dehumidifier will be held in the 'Fault' condition by (PLC1). To restart the dehumidifier clear the alarm pressing the acknowledge ACK on the HMI, reset the overload, and go to the ALARM screen and press the F4 RESET key this resets the PLC. To restart the system, the selector switch (SS01) must be moved to the “OFF” position, then move (SS01) back to the “AUTO” or “MANUAL” position.

5.0 List of System and DH Warnings

5.1 *WARNING* – REACTIVATION LOW TEMP

5.1.1 LOW TEMP (Reactivation Low Temperature Fault Set point). The adjustment range is 90.0 to 110.0. The parameter corresponds to the value of the set point in engineering units (Typical Set point = 110° F).

6.0 PROPORTIONAL CONTROL LOOPS/ DH INTERLOCKS

6.1 Reactivation Heat Energy Control

6.1.1 The Reactivation Heater “Energy Modulation Damper (DA01)” accepts a 0-10V modulating signal from the logic controller to control Reactivation Outlet air temperature, as sensed by the reactivation air outlet temperature transmitter (TC02), at its predetermined set point (Set point = 120°F).

6.2 Dehumidification Humidistat Interlock

6.2.1 The Humidistat is an ON/OFF Controller (HS01), and is furnished to interlock the Dehumidifier heel and associated controls, based on moisture removal demand.

6.2.2 Provided that the System is running, as the humidity level, as sensed by (HS01), exceeds the desired set point, HS01 will close contacts energizing relay (CR69) which, in turn, signals the PLC (PLC1) to start the Dehumidifier.

6.2.3 The PLC (PLC1) will enable the Desiccant Wheel Drive Motor Starter/ Relay (CR01), Reactivation Fan Motor Starter (MS02), and the associated Reactivation Energy modulation controls.

6.2.4 When the humidity level, as sensed by (HS01) decreases below the desired set point, the Dehumidifier will initial a 90 second purge/ shutdown sequence. Upon completion of the purge sequence, the PLC (PLC1) will de-energize the Desiccant Wheel Motor Starter/ Relay (CR01), Reactivation Fan Motor Starter (MS02) and associated Reactivation Energy Modulation controls. The Operator Interface (OIT1) will display Dehumidifier: STANDBY (if system is still running) or “READY” (if the system is stopped).

7.0 HUMAN MACHINE INTERFACE CONTROL (OP73 SIMATIC PANEL)

7.1 Screen descriptions, navigation and security:

* Indicates a level of security to adjust equipment parameters.
Note: Other visual options are password protected for FACTORY USE ONLY.

7.1.1 System Screen This screen is the first screen that comes up when power is applied to the equipment (figure 1.0). The System screen displays the equipments operational status along with separate indication for the

Reactivation air stream. The System screen also acts as the navigation portal for all of the screens configured in the system. All navigation references in this section assume the operator starts on the System screen. At anytime during navigation the ESC button on the Simatic Panel may be pressed twice to return to the System screen.

Equipment Status Indications

"SYSTEM" displays the modes of operation of the process as listed below:

READY = The system is ready to run and there are no faults and the interlocks are made.
RUNNING = The system is running and process control loops are running if they are enabled.
FAULTED = The system has faulted.
PURGING = The system is going thru a shutdown sequence and is purging.

"REACT" displays the modes of operation of the dehumidifier as listed below:

READY = The DH is ready to run and there are no faults and the interlocks are made.
RUNNING = The DH is running and process control loops are running if they are enabled.
FAULTED = The DH has faulted.
PURGING = The DH is going thru a shutdown sequence and is purging.
STANDBY = The System is Running and the DH is stopped because there is no call for dehumidification (full bypass).

7.2 Reactivation Temperature Pressing the Up Arrow twice navigates to this screen (figure 1.2). The Reactivation Temperature screen displays the real time indication of the reactivation inlet and outlet temperatures (degrees Fahrenheit).

7.3 Date/Time Pressing the Up Arrow twice navigates to this screen (figure 1.3). The Date/Time screen displays the current date and time. This may be configured by the customer using the correct username and password. The display will change to the Username and Password screen (figure 1.7), prompted by pressing F1.

7.4 Username & Password The operator will be prompted by the appearance of the password screen (figure 1.7) on occasions where secure parameters are attempting to be accessed. Enter the Username and Password supplied with the equipment O&M to proceed. Then ENTER button will reverse highlight the character for editing. Use the arrows buttons as necessary to select the desired characters. Once the last character has been located press ENTER, to proceed to the password window. Press ENTER again to allow editing again for the password. Once the last character has been located press ENTER, DOWN ARROW, then the "OK" shall display a dotted box within, press ENTER to accept and the screen will return to make the selection without security restriction. (default user is "MAINT", password is "dhi").

7.5 Run Time Meter Pressing the Down Arrow once navigates to this screen (figure 1.4). The Run Time Meter screen displays the amount of time in hours that the equipment has been in operation. There is an indication for DH displaying the amount of time dehumidification has been requested and in operation. These values, shown in hours, may vary dependant on the equipments configuration.

7.6 Control Group Selection 1* Pressing F1 (PID) will navigate to this screen (figure 1.8). The OP73 Display may prompt the operator for Username and Password (figure 1.7); this must be entered to proceed (section 4.4). The Control Group Selection 1 screen displays the various system loops available on the equipment.

7.7 Alarms Pressing F2 (ALM) will navigate to this screen (figure 1.5). The Alarm screen displays the Faults and Warnings the system encountered during operation. The triangle with exclamation point will indicate to the operator when an alarm condition exists. The current alarm message may be cleared without clearing the history by pressing the ACK button.

The Alarm Screen displays and records information on triggered alarms. Each time an alarm is triggered, it is added to the Alarm History list (figure 1.6), and the last alarm shall be displayed.

7.7.1 F4 RESET The operator must press the F4 button to reset a fault in the PLC; this will clear all system faults and enable the equipment to be restarted by cycling the selector switch. The selector switch may also be used as the system reset by turning it to the off position and return it to the auto or manual position. The acknowledge button (ACK) must be pressed to clear the message and alarm symbol indication. The system screen will display READY after a fault has been reset.

7.7.2 F1 CLEAR History The alarm history (figure 1.6.) can be viewed by pressing the down arrow first and both up and down arrows to scroll the alarms stored. Clearing the alarm history press F1. It will prompt for the Username and Password, upon entering the correct characters the operator has the ability to clear the history.

7.8 React PID Pressing F1 (REACT) while on the Control Group 1 screen will navigate to this screen (figure 1.9). In the React PID screen the operator may adjust the reactivation temperature set-point (R_SP). To set the value Press ENTER and the Black highlight will change to the right most character. Utilize the arrow buttons to change any of the values to the desired numeric temperature value. This temperature is in degrees Fahrenheit.

Reactivation PID Parameter Pressing the down arrow while on the React PID screen will navigate to this screen (figure 2.0). Here the operator may adjust the Reactivation Heat Loop parameters for tuning the equipment. Pressing F1 will save these values to memory in the PLC allowing the values to remain in case of power failure or shutdown. The equipment is designed to save these parameters every hour regardless if the Save Recipe is pressed.

Temperature Sensor Min/Max Pressing the down arrow once more from the PID parameter screen will navigate to this screen (figure 2.1). Here the operator may adjust the sensor maximum and minimum. To set the values Press ENTER and the Black highlight will change to the right most character. Utilize the arrow buttons to change any of the values to the desired numeric values. Pressing F1 will save these values to memory in the PLC allowing the values to remain in case of power failure or shutdown. The equipment is designed to save these parameters every hour regardless if the Save Recipe is pressed.

8.0 SIMATIC PANEL SCREEN SHOTS

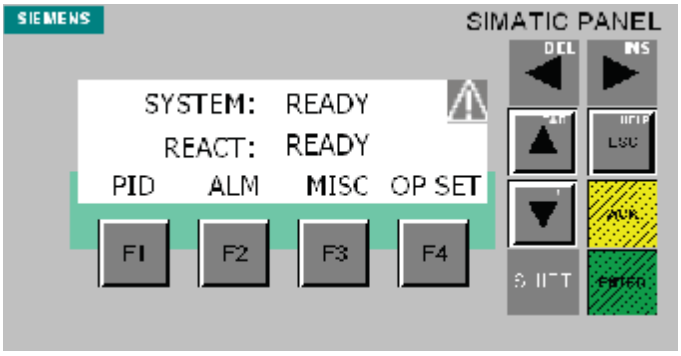

Figure 1.0

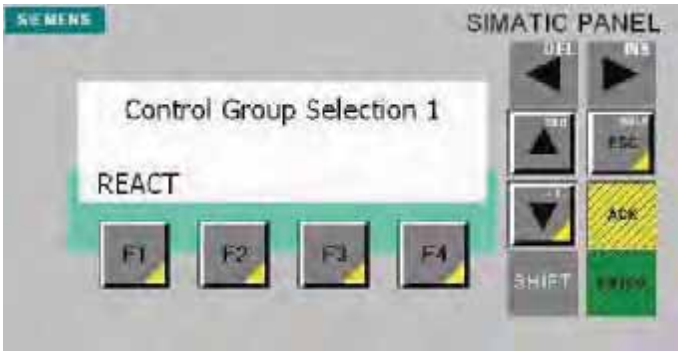

Figure 1.1

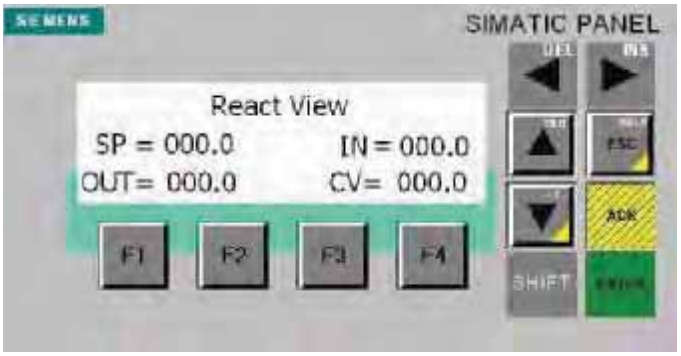

Figure 1.2

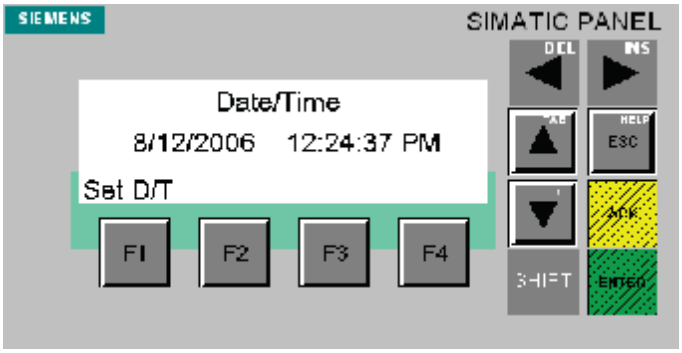

Figure 1.3

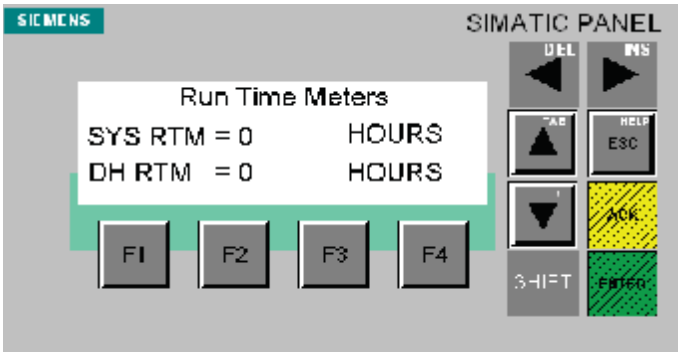

Figure 1.4

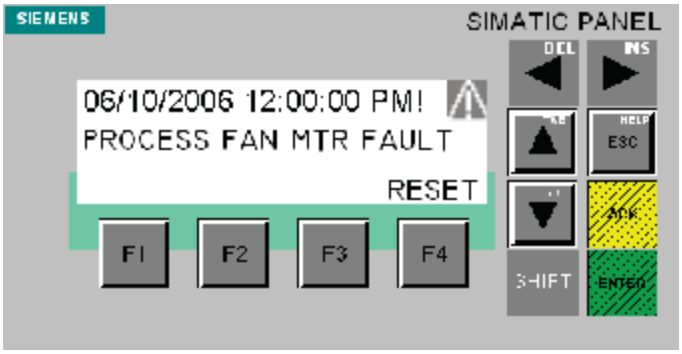

Figure 1.5

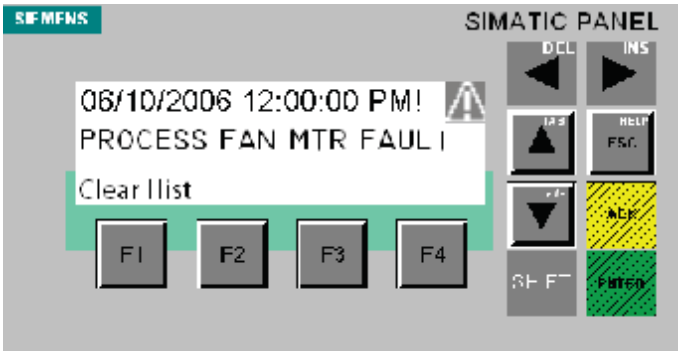

Figure 1.6

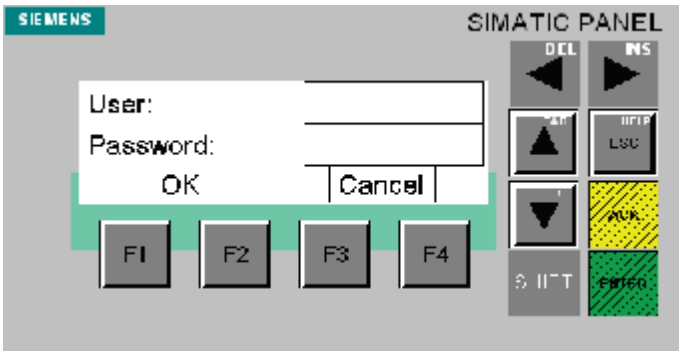

Figure 1.7

Munters Corporation **Dehumidification Division** **79 Monroe Street** **Amesbury, MA 01913**	DFT SAE	DATE 12/12/07	DWG NO. **K70203**
	CHK CAG	12/12/07	CUST NAME: **HCD1125 thru 9000-SA / ICA-0500 thru 1500 (STANDARD)**
	APP CAG	12/12/07	PAGE 7 OF 8 / REV 2

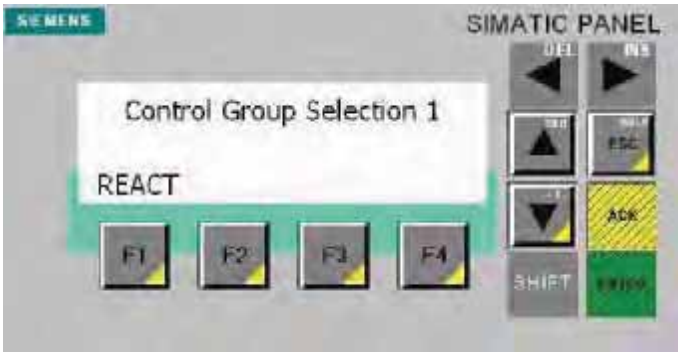

Figure 1.8

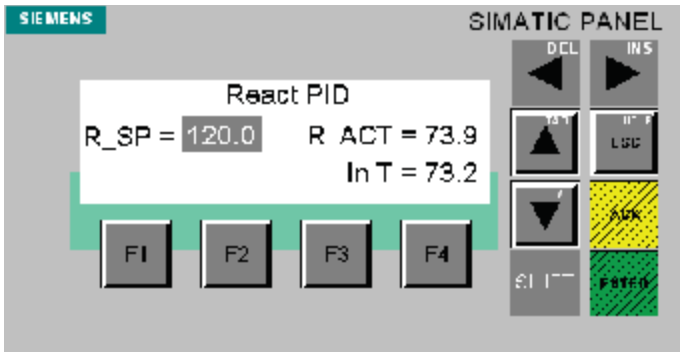

Figure 1.9

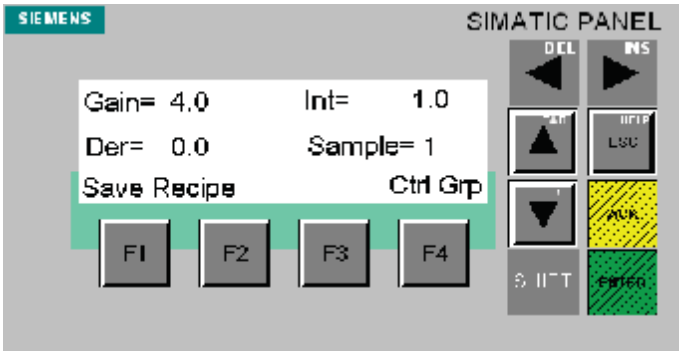

Figure 2.0

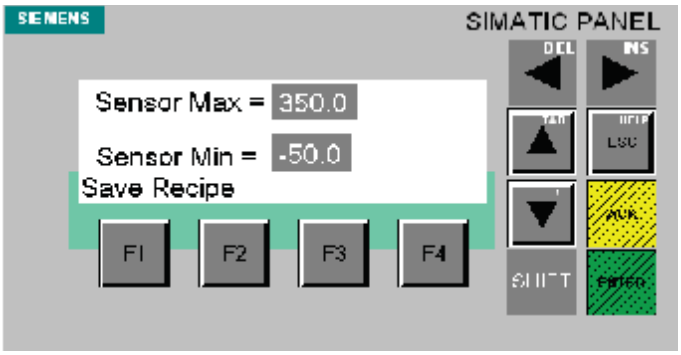

Figure 2.1

REV	DESCRIPTION	DFT	DATE	APP
2	MODIFIED FAULTS	RDS	09/23/09	RDS
1	CHANGE DESCRIPTION FROM 2250 TO 9000	SAE	12/10/07	CAG

REVISIONS

Munters Corporation
Dehumidification Division
79 Monroe Street
Amesbury, MA 01913

DFT SAE	DATE 12/12/07	DWG NO. **K70203**	
CHK CAG	12/12/07	CUST NAME: **HCD1125 thru 9000-SA / ICA-0500 thru 1500 (STANDARD)**	
APP CAG	12/12/07	PAGE 8 OF 8	REV 2

System type	HCD	Prepared by	Greg Ducharme
Plenum size	HCD-2250	Print date	8/5/2013 12:27:23 PM
Name	21226711 - Buffalo Air Handling	Project Name	
Genesys No	G104169-1		

Technical Data

Reactivation Filter

Dehumidifier Model	HCD-2250
Filter Efficiency	MERV 8
Filter Efficiency Bank 2	MERV 11
Filter Pressure Drop Design	1.50 in WC
Filter Pressure Drop Clean	0.28 in WC
Filter Pressure Drop Dirty	1.50 in WC
Face Area	2.25 ft²
Face Velocity	213 ft/min
Filter Dimensions	Qty 1 @ 24in x 24in
Filter Dimensions Bank 2	Qty 1 @ 24in x 24in

AAF INTERNATIONAL

Better Air is Our Business®

AmericanAirFilter

AmAir® 300X
AmAir® HT

1", 2" and 4" Extended Surface Pleated Panel Filters

AmAir® 300X filters meet the performance requirements of the most demanding applications.

- ***Expanded metal pleat support grid (AmAir® 300X)***
- ***High loft media increases dust holding capacity***
- ***Excellent primary filter to prevent dust build-up on heating and cooling coils, fans, and ductwork***
- ***Excellent prefilter for higher efficiency filters***
- ***Directly interchangeable with disposable panel filters, media pads in metal frames, or permanent filters used in built-up filter banks and side access systems. No modifications are necessary to frames or latches***
- ***4" filters have pleat stabilizers to ensure uniform spacing and increase rigidity (AmAir® 300X)***

AmAir® 300X

AmAir® 300X filters are constructed with AAF's totally unitized, double wall, die-cut box, beverage board frame. The media pack is bonded inside the frame at all points of contact. AmAir 300X filters are built rugged for durability and reliability under tough service conditions. AmAir 300X is rated MERV 7 (25-30% average ASHRAE efficiency).

Superior Strength

AmAir 300X filters are extremely strong and durable, with all components rigidly bonded into a totally unitized construction. They will not rack or deteriorate under normal operating conditions, including high moisture applications.

An expanded metal grid laminated to the air leaving side of the media creates more consistent pleat shape and maintains uniform pleat spacing. Expanded metal also increases the stability of the pleat pack, reducing media flutter during operation.

The media pack support retainers, which are an integral part of the frame, are bonded to the pleats on both the air entering and the air leaving sides. This increases rigidity and also helps maintain proper spacing between pleats for maximum dust holding capacity while minimizing resistance.

AmAir® HT High Temperature

AmAir® HT is designed for applications with continuous operating temperatures up to 500˚F (260˚C). AmAir HT is rated UL Class 1 with 30-35% average ASHRAE efficiency. The frame is an aluminized steel U-channel, with the media pack bonded to the inside on all four edges. An expanded aluminized steel faceguard is spot welded inside the frame on the air leaving side to retain the media pack at elevated temperatures. AmAir HT is made with micro-glass media.

AmericanAirFilter®

AmAir® 300X
AmAir® HT

Product Information — [1]Standard Sizes

[2]Nominal Sizes (Inches) (W x H x D)	Actual Sizes (Inches) (W x H x D)	Rated Airflow Capacity (SCFM) 300 FPM	500 FPM	625 FPM	300X Pleats Per Filter	300X Gross Media Area (sq. ft.)	HT Pleats Per Filter	HT Gross Media Area (sq. ft.)
10 x 10 x 1	9 3/8 x 9 3/8 x 7/8	200	350	---	11	1.5	---	---
12 x 24 x 1	11 3/8 x 23 3/8 x 7/8	600	1000	---	14	4.6	---	---
16 x 20 x 1	15 3/8 x 19 3/8 x 7/8	650	1100	---	20	5.5	---	---
16 x 25 x 1	15 3/8 x 24 3/8 x 7/8	850	1400	---	20	6.8	---	---
20 x 20 x 1	19 3/8 x 19 3/8 x 7/8	850	1400	---	24	6.6	---	---
20 x 25 x 1	19 3/8 x 24 3/8 x 7/8	1050	1750	---	24	8.2	---	---
24 x 24 x 1	23 3/8 x 23 3/8 x 7/8	1200	2000	---	28	9.3	---	---
12 x 24 x 2	11 3/8 x 23 3/8 x 1 3/4	600	1000	1250	15	9.4	13	7.4
16 x 20 x 2	15 3/8 x 19 3/8 x 1 3/4	650	1100	1400	19	9.9	17	8.2
16 x 25 x 2	15 3/8 x 24 3/8 x 1 3/4	850	1400	1750	19	12.4	17	10.1
18 x 24 x 2	17 3/8 x 23 3/8 x 1 3/4	900	1500	1875	21	13.2	---	---
20 x 20 x 2	19 3/8 x 19 3/8 x 1 3/4	850	1400	1750	24	12.5	21	10.1
20 x 24 x 2	19 3/8 x 23 3/8 x 1 3/4	1000	1650	2100	24	15.0	21	12.0
20 x 25 x 2	19 3/8 x 24 3/8 x 1 3/4	1050	1750	2175	24	15.7	21	12.5
24 x 24 x 2	23 3/8 x 23 3/8 x 1 3/4	1200	2000	2500	28	17.6	25	14.3
12 x 24 x 4	11 3/8 x 23 3/8 x 3 3/4	600	1000	1250	11	12.8	11	14.0
16 x 20 x 4	15 3/8 x 19 3/8 x 3 3/4	650	1100	1400	14	14.0	14	14.9
16 x 25 x 4	15 3/8 x 24 3/8 x 3 3/4	850	1400	1750	14	17.5	14	18.5
18 x 24 x 4	17 3/8 x 23 3/8 x 3 3/4	900	1500	1900	16	19.4	---	---
20 x 20 x 4	19 3/8 x 19 3/8 x 3 3/4	850	1400	1750	18	18.3	18	19.1
20 x 25 x 4	19 3/8 x 24 3/8 x 3 3/4	1050	1750	2150	18	22.9	18	23.8
24 x 20 x 4	19 3/8 x 23 3/8 x 3 3/4	1000	1650	2100	21	22.6	18	22.9
24 x 24 x 4	23 3/8 x 23 3/8 x 3 3/4	1200	2000	2500	21	27.1	22	27.9
25 x 29 x 4	24 3/8 x 28 3/8 x 3 3/4	1500	2500	3150	25	33.5	---	---

(1) Additional sizes available (AmAir 300X):

10x20x1	14x20x1	15x20x1	18x24x1	25x25x1	15x20x2	16x24x2	25x25x2
12x12x1	14x25x1	16x16x1	18x25x1	12x20x2	16x16x2	18x25x2	24x20x4

(2) Other standard size and special size AmAir 300X filters are available in handmade construction assembled from four beverage board strips. The filters are stapled in each corner with the pleated media pack bonded to the inside of the frame. Special sizes are available in the same construction, or can be made from standard size filters which are cut down and "capped" with beverage board strips.

(3) Width and height dimensions are interchangeable. All AmAir filters may be installed with the pleats either vertical or horizontal.

Performance Data

	Pleats Per Lineal Foot	[1]Rated Initial Resistance (in. w.g.) 300 FPM	500 FPM	625 FPM	Recommended Final Resistance (in. w.g.)	[1]Rated Average Efficiency (%)	[1]Rated Average Arrestance (%)	Continuous Operating Temperature Limits ˚F	˚C
AmAir 300X									
1"	14.0	.20	.45	---	1.0	25-30	90-92	200	93
2"	14.0	.13	.28	.44	1.0	25-30	90-92	200	93
4"	11.0	.12	.25	.36	1.0	25-30	90-92	200	93
AmAir HT									
2"	13.0	.20	.43	.60	1.2	30-35	95-97	500	260
4"	11.0	.18	.40	.57	1.2	30-35	95-97	500	260

(1) All performance data is based on the ASHRAE 52.1-1992 test method. Performance tolerance conform to Section 7.4 or ARI Standard 850-93.

Underwriters Laboratories Classification
AmAir HT filters are classified UL Class 1. AmAir 300X filters are classified UL Class 2. Testing was performed according to UL Standard 900 and CAN -S111.

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Louisville, Kentucky 40223-6169

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Customer Service 888.AAF.2003
Fax 888.223.6500

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AFP-1-165V JUN '09 QG 3M

AmericanAirFilter®

VariCel®

High and Medium Efficiency
Extended Surface
Supported Pleated Filters

VariCel® with Antimicrobial

IAQ Engineered Media Treated
with Antimicrobial

Better Air is Our Business®

AmericanAirFilter®

VariCel® and VariCel® with Antimicrobial

Extended Surface Supported Pleated Filters

- ***Available in three efficiencies MERV 14 (90-95%), MERV 13 (80-85%), and MERV 11 (60-65%)***
- ***Available with antimicrobial in 90-95% & 60-65% efficiency***
- ***UL Class 1***
- ***Ideal for difficult operating conditions***
  - ***Variable air volume***
  - ***Turbulent airflow***
  - ***Repeated fan shutdown***
  - ***High temperature operation***
  - ***High humidity***
  - ***Intermittent exposure to water such as seacoast installations***

VariCel® MERV 13 filters and higher meet efficiency requirements established for LEED® Project Certification.

Designed to Improve Indoor Air Quality

VariCel filters with antimicrobial are designed specifically to improve Indoor Air Quality (IAQ). Air filters are designed to trap and concentrate particulate air contaminants including viable fungal and bacterial spores. The presence of antimicrobial preservative in the filter media is intended to preserve the integrity of the media throughout the useful life of the filter. Antimicrobial preservatives are not meant to increase the efficiency of the filter, nor to kill microorganisms "on the fly" as they pass through a filter. Antimicrobial is EPA registered and environmentally safe.

Engineered for a Variety of Applications

Type SH Single Header VariCel filters are designed for systems originally supplied by AAF International. A unique $^{13}/_{16}$" flanged header on the air entering side allows the filter to be easily inserted and latched into front and side access systems.

Type DH Double Header VariCel filters are designed to upgrade air cleaning performance and reliability. Two $^{13}/_{16}$" thick flanged headers make the filters compatible with the holding frames and latching devices of various manufacturers, including rear access systems.

XL Series VariCel filters, single header (XL-S) and double header (XL-D), contain up to 67% more media and offer more than twice the service life of standard single and double header models.

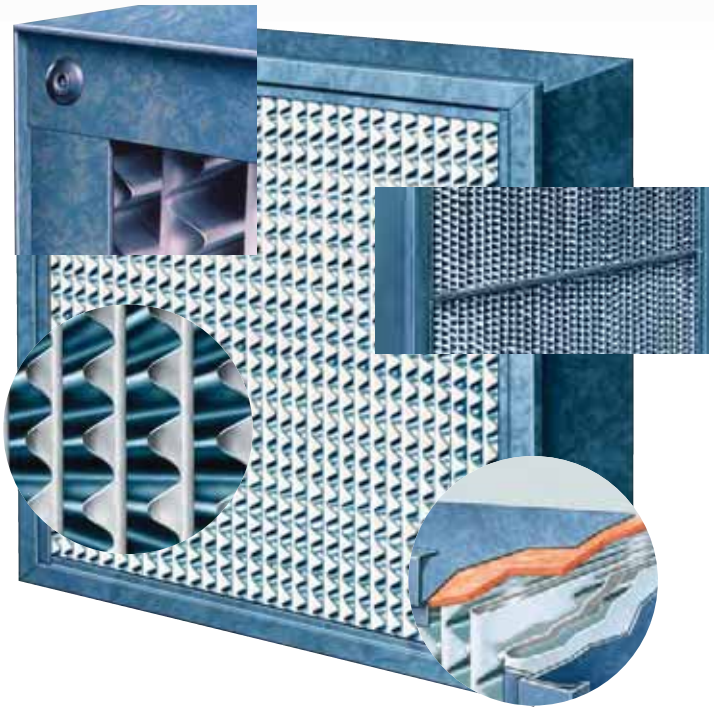
High Temp Series VariCel filters are designed for systems operating from 350°-900°F. Constructed of aluminized steel, High Temperature VariCel filters offer rated efficiency with proven reliability over the life of the filter. See page 4 for models and temperature limits.

Type NH Series VariCel filters are designed for special sizes and applications, including incineration and compaction disposal systems. Manufactured of fire-retardant, $^{3}/_{4}$" thick, heavy wall particle board, Type NH VariCel filters (U.L. Class 1) are operable at temperatures up to 200°F. The filters are constructed without headers and cell sides are flush with front face dimensions.

Built Rugged for Dependable Performance

Crimped Rear Flanges *(SH) are rolled over and riveted to add strength, eliminate sharp edges, and prevent bypass leakage.*

Corrugated Aluminum Separators with Rolled Edges *maintain uniform pleat spacing for optimum airflow. The separators are rolled to eliminate sharp edges, preventing media damage during shipping and personal injury during installation.*

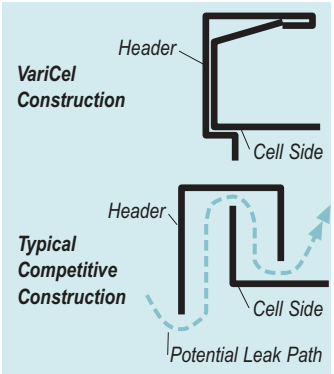


Media Pack Restraint
Steel brace on air leaving side adds support to the media pack.

Media Pack Sealant *— A layer of high efficiency media seals the media pack into the cell sides. The media sealant prevents by-pass leakage and damage to the media and separators during shipping and handling. By allowing slight movement of the media pack when the filter is jarred, the cushioning sealant helps prevent tears and punctures to the media.*

VariCel's rigid construction with supported pleat media pack maintains a compact, unitized structure even under tough operating conditions. Variable air velocity and repeated fan shutdown do not compromise performance.

Unitized Construction
Interlocked header and cell sides, along the entire length of each side, provide maximum sealing. Competitive filters are designed with loose fitting headers which allow greater potential for bypass leakage.



Pleats and Separators Bonded For Strength
During the pleating process, spots of glue are applied to bond each separator to the adjacent pleat. This solidifies the media pack to minimize movement and prevent media damage. Burst strength is increased to prevent the filter from blowing out under variable air volume conditions or unusually high resistance.

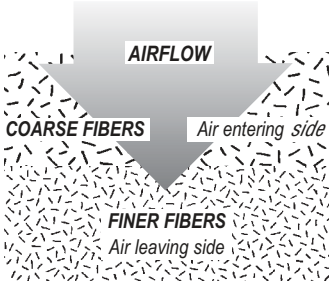
Galvanized steel headers and cell sides resist damage during shipping and handling, and prevent corrosion over long service life. (HT VariCel filters are constructed of aluminized steel.)

Easy Installation
Rigid construction and minimum depth make VariCel filters easy to install in all types of systems.

Dual Density Media Reduces Operating Costs

VariCel media is manufactured with two layers of glass fibers: coarser fibers on the air entering side, and finer fibers on the air leaving side.

Our dual density design allows dirt particles to be collected throughout the entire depth of the filter utilizing the full cleaning potential of the media. Maximum dust holding capacity extends the life of the filter, minimizing operating costs.



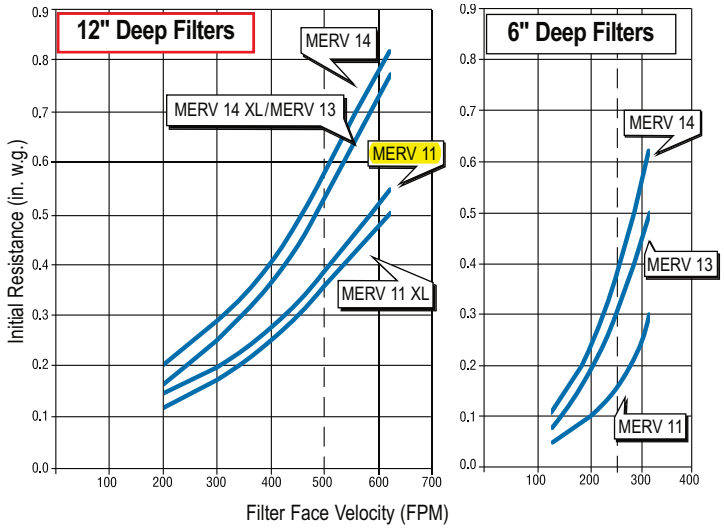
The water resistant media can withstand intermittent exposure to water, making VariCel filters ideal for installations in humid areas or where the filters are exposed to moisture.

AmericanAirFilter®

VariCel® and VariCel® with Antimicrobial

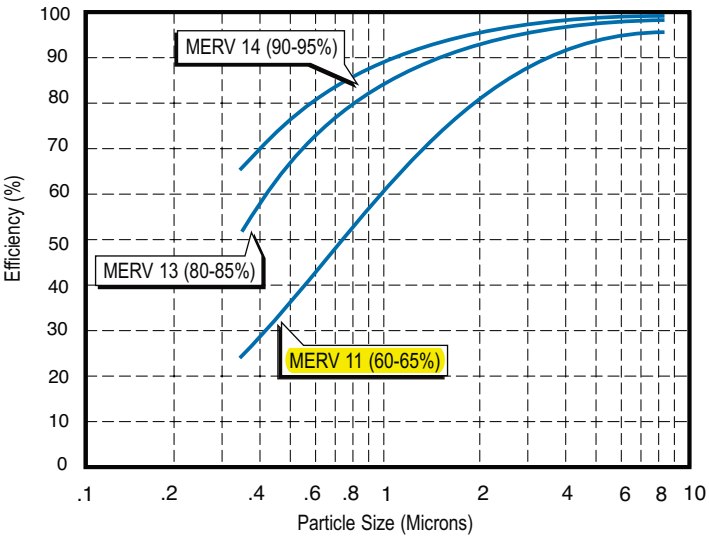
Operating Data

Initial Resistance vs. Filter Face Velocity



12" deep filters are rated at 500 FPM filter face velocity.
6" deep filters are rated at 250 FPM filter face velocity.
Recommended final resistance for all VariCel filters is 1.5" w.g.

Efficiency by Particle Size*



** Tested in accordance with ASHRAE Standard 52.2-2007.*

Operating Temperature Limits

VariCel Model	Temperature Limit	
Types SH, DH, XL	350°F	177°C
Type HT-500	500°F	260°C
Type HT-725	750°F	385°C
Type HT-900	900°F	482°C
Type NH	200°F	93°C

Underwriters Laboratories Inc. Classification: All VariCels are Class 1. Testing was performed according to UL Standard 900 and CAN 4-S111.

Prefilters Can Double VariCel® Life

Using prefilters, such as AAF's PerfectPleat® pleated filters or "5700" panel filters, will greatly extend the life of VariCel filters.

Options

- *VariCel filters can be ordered with faceguards made of flattened, expanded, galvanized, or aluminized steel on one or both sides of the filter.*
- *Factory installed gaskets are available on the front or back of the header.*
- *Vinyl coated separators are available for corrosive conditions.*
- *1 1/8" Single Header VariCels, designed for other manufacturers' equipment, are also available.*

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Louisville, Kentucky 40223-6169

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Customer Service 888.AAF.2003
Fax 888.223.6500

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ISO Certified 9001:2000

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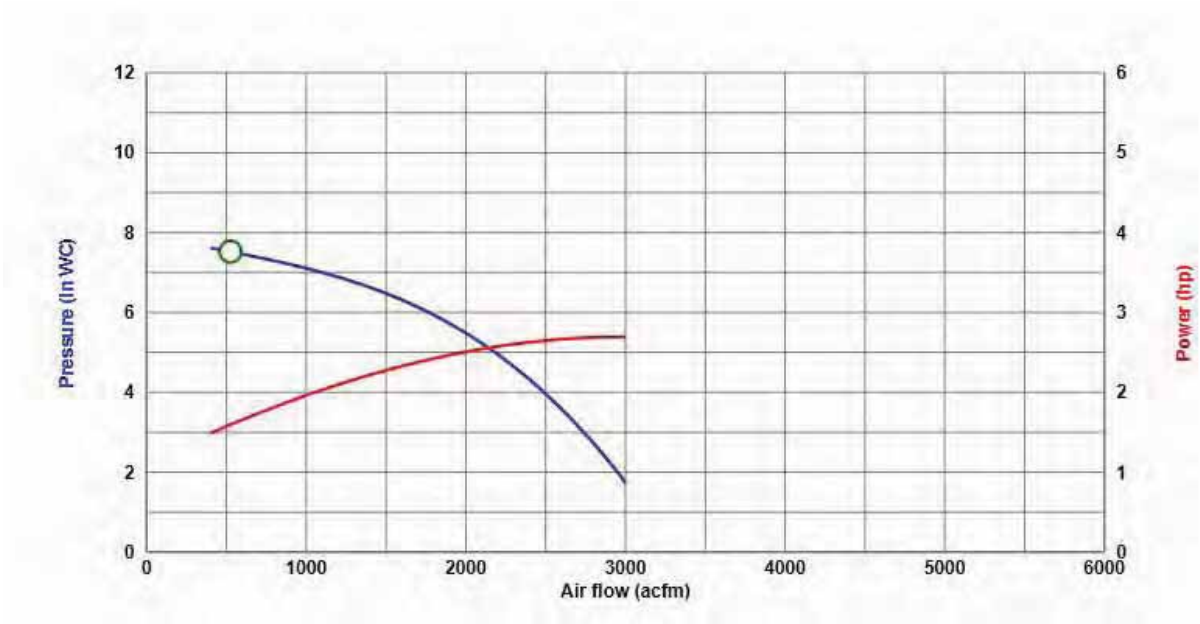
AFP-1-158W FEB '09 VI 5M

System type	HCD	Prepared by	Greg Ducharme
Plenum size	HCD-2250	Print date	8/5/2013 12:27:23 PM
Name	21226711 - Buffalo Air Handling	Project Name	
Genesys No	G104169-1		

Technical Data

Reactivation Fan



Dehumidifier Model	HCD-2250
Outlet Options	Bolt Pattern
Fan Size	12-1/4
Percent Width	100%
Drive Type	Direct
Fan Speed	3450 rpm
Fan Discharge Orientation	Upblast
Fan Type	SWSI Airfoil
Motor HP	3
Motor Type	TEFC
Full Load Amps	4.80 A

Fan Max Speed	3450 rpm
Inlet Air Temperature	115.0 °F
Leaving Air Temperature	122.7 °F
Air Flow Out	480 SCFM
Fan Total Static Pressure	7.39 in WC
Fan Mechanical Efficiency	35.88 %
Fan Speed	3450 rpm
Fan Shaft Power	1.59 hp
External Static Pressure	3.79 in WC

Customer:
Contact:
Telephone:
Cell:
Fax:
Job:
Quote #:

Date: 9/3/2013
From:
Company:
Return Tel:
Return Fax:

Construction

Item:	React Coil # 1
Coils Per Bank:	1
Allow Opp. End:	No
Tube OD IN:	5/8
Style:	Distributing
Fins Per Inch:	10
Rows:	2
Fin Surface:	B
Fin Height (IN):	12.00
Finned Length (IN):	12.00
Tubing Mat. (IN):	0.049 Copper
Fin Mat. (IN):	0.0095 Aluminum
Face Area (SQ FT):	1.00
SJC:	13A/0

Air Side

Air Flow (Sft^3/min)	490.0
Altitude FT:	0.00
Ent. Air DB °F:	50.00
Lvg. Air DB °F:	287.0
Total Capacity MBH:	0.00
Max Air PD "H2O:	0.00

Steam Side

Pressure lbf/in^2:	96.00

OUTPUT DATA				OPTIONS	
Model Number:		5GA1002B		Casing Material:	Galvanized
Air Velocity:	(Sft/min)	490.0		Casing Type:	Flanged
Total Capacity:	MBH	76.83		Hand:	N/A
Lvg. Air DB:	°F	194.0		Connection Material:	Carbon Steel
Standard APD	"H2O	0.18		Connection Type:	MPT
Condensate:	lbm/hr	87.40		Vent/Drain:	.50 FPT on Face
Conn. Size:	IN	1.50 / 1.25		Label Kit:	Yes
Weight:	lbm	24.22		Coating: None	
Notes:		AK		Mounting Holes:	Yes
				Drain Headers:	No
				Boxed Headers:	No

Notes:

A) AHRI Certified And Rated In Accordance With AHRI 410.

K) Coil rating valid for Heatcraft coils only.

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Job:
Quote #:

Date: 9/3/2013
From:
Company:
Return Tel:
Return Fax:

Construction

Item:	React Coil # 2
Coils Per Bank:	1
Allow Opp. End:	No
Tube OD IN:	5/8
Style:	Distributing
Fins Per Inch:	10
Rows:	2
Fin Surface:	B
Fin Height (IN):	12.00
Finned Length (IN):	12.00
Tubing Mat. (IN):	0.049 Copper
Fin Mat. (IN):	0.0095 Aluminum
Face Area (SQ FT):	1.00
SJC:	13A/0

Air Side

Air Flow (Sft^3/min)	490.0
Altitude FT:	0.00
Ent. Air DB °F:	194.0
Lvg. Air DB °F:	287.0
Total Capacity MBH:	0.00
Max Air PD "H2O:	0.00

Steam Side

Pressure lbf/in^2:	96.00

OUTPUT DATA				OPTIONS	
Model Number:		5GA1002B		Casing Material:	Galvanized
Air Velocity:	(Sft/min)	490.0		Casing Type:	Flanged
Total Capacity:	MBH	34.29		Hand:	N/A
Lvg. Air DB:	°F	258.3		Connection Material:	Carbon Steel
Standard APD	"H2O	0.18		Connection Type:	MPT
Condensate:	lbm/hr	39.00		Vent/Drain:	.50 FPT on Face
Conn. Size:	IN	1.50 / 1.25		Label Kit:	Yes
Weight:	lbm	24.22		Coating: None	
Notes:		BEK		Mounting Holes:	Yes
				Drain Headers:	No
				Boxed Headers:	No

Notes:

B) Rated In Compliance With AHRI 410.
E) Rated in Accordance with AHRI 410, actual performance may vary by application
K) Coil rating valid for Heatcraft coils only.

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Customer:
Contact:
Telephone:
Cell:
Fax:
Job:
Quote #:

Date: 9/3/2013
From:
Company:
Return Tel:
Return Fax:

Construction

Item:	React Coil # 3
Coils Per Bank:	1
Allow Opp. End:	No
Tube OD IN:	5/8
Style:	Distributing
Fins Per Inch:	10
Rows:	2
Fin Surface:	B
Fin Height (IN):	12.00
Finned Length (IN):	12.00
Tubing Mat. (IN):	0.049 Copper
Fin Mat. (IN):	0.0095 Aluminum
Face Area (SQ FT):	1.00
SJC:	13A/0

Air Side

Air Flow (Sft^3/min)	490.0
Altitude FT:	0.00
Ent. Air DB °F:	258.3
Lvg. Air DB °F:	287.0
Total Capacity MBH:	0.00
Max Air PD "H2O:	0.00

Steam Side

Pressure lbf/in^2:	96.00

OUTPUT DATA				OPTIONS	
Model Number:		5GA1002B		Casing Material:	Galvanized
Air Velocity:	(Sft/min)	490.0		Casing Type:	Flanged
Total Capacity:	MBH	17.78		Hand:	N/A
Lvg. Air DB:	°F	291.6		Connection Material:	Carbon Steel
Standard APD	"H2O	0.18		Connection Type:	MPT
Condensate:	lbm/hr	20.22		Vent/Drain:	.50 FPT on Face
Conn. Size:	IN	1.50 / 1.25		Label Kit:	Yes
Weight:	lbm	24.22		Coating: None	
Notes:		BEK		Mounting Holes:	Yes
				Drain Headers:	No
				Boxed Headers:	No

Notes:

B) Rated In Compliance With AHRI 410.
E) Rated in Accordance with AHRI 410, actual performance may vary by application
K) Coil rating valid for Heatcraft coils only.

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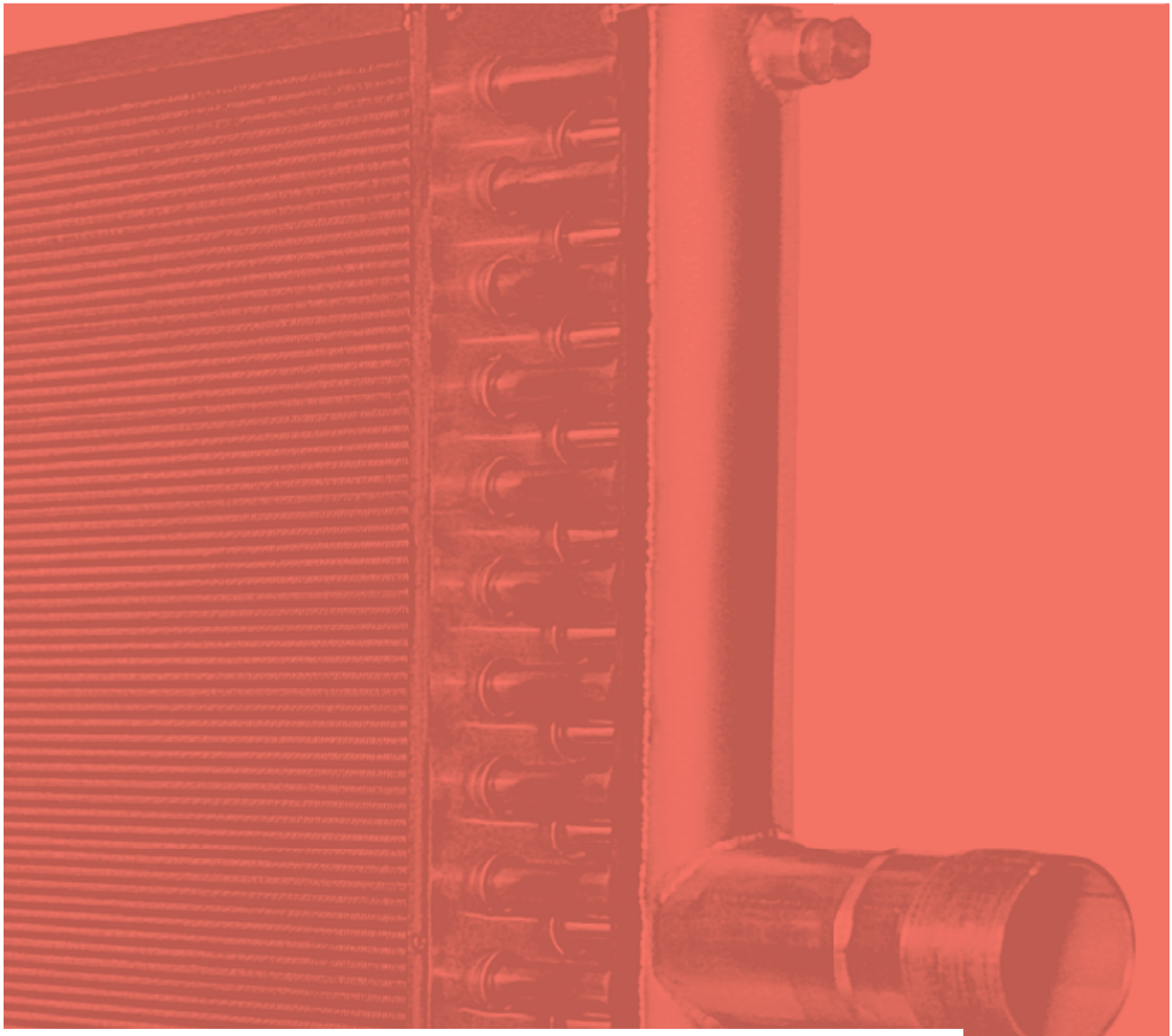


HEATCRAFT™

Steam Coil Installation, Operation and Maintenance

LUVATA

Partnerships beyond metals

26617

STEAM IOM

Guidelines for the installation, operation and maintenance of Heatcraft steam heating coils have been provided to help insure the proper performance of the coils. These are general guidelines that may have to be tailored to meet the specific requirements of any one job. As always, the installation and maintenance of any coil should be performed by a qualified party or individual. Protective equipment such as safety glasses, steel toe boots, and gloves are recommended during the installation and routine maintenance of the coil.
Caution! Steam, even at low pressure, can cause serious bodily injury that may result in death. Be sure the system is off or the components are isolated before beginning work.

Receiving Instructions

1. All Heatcraft coils are factory tested, inspected and carefully packaged.
2. Damage to the coils can occur after they have left the factory. Therefore, the coils should be inspected for shipping damage upon receipt. The freight bill should also be checked against items received for complete delivery.
3. Damaged and/or missing items should be noted on the carrier's freight bill and signed by the driver.
4. For additional assistance, contact your local Luvata coil representative.

Nomenclature

5 SA 12 1 C 24.00 x 144.00

Tube OD

5 = 0.625" or 8 = 1"

Finned Length

Fin Height

Fin Design

A - Flat (AL, CU)
B - corrugated (AL,CU)
C - sine wave (AL, CU)
F - flat (SS, CS)
G - corrugated (SS, CS)
H - sinewave (SS, CS)

Rows Deep

Fins Per Inch

Coil Type

5JA, 8JA: Distributing tube, same end conn
5GA, 8GA: Distributing tube, same end conn (high pressure)
5DA, 8DA: Distributing tube, dual supply, opp end conn
5LA, 8LA: Distributing tube, dual supply, opp end conn (high pressure)
5RA, 8RA: Distributing tube, opp end conn
5TA, 8TA: Distributing tube, opp end conn (high pressure)
5SA, 8SA: Single tube, opp end conn
5HA, 8HA: Single tube, opp end conn (high pressure)
5SB: Single tube, opp end conn, 3" center-to-center
5HB: Single tube, opp end conn, 3" center-to-center (high pressure)
5SS: Single tube, same end conn
5SH: Single tube, same end conn (high pressure)

Figure1a - Case Pitched

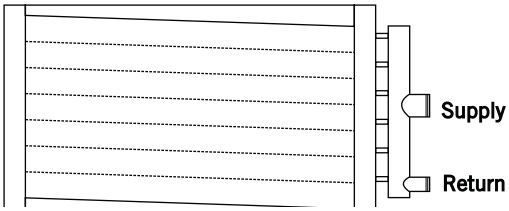
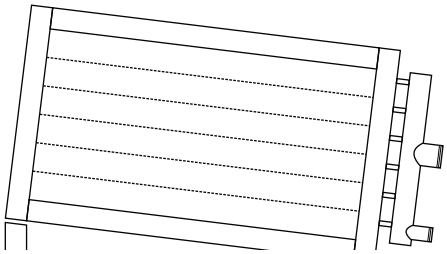


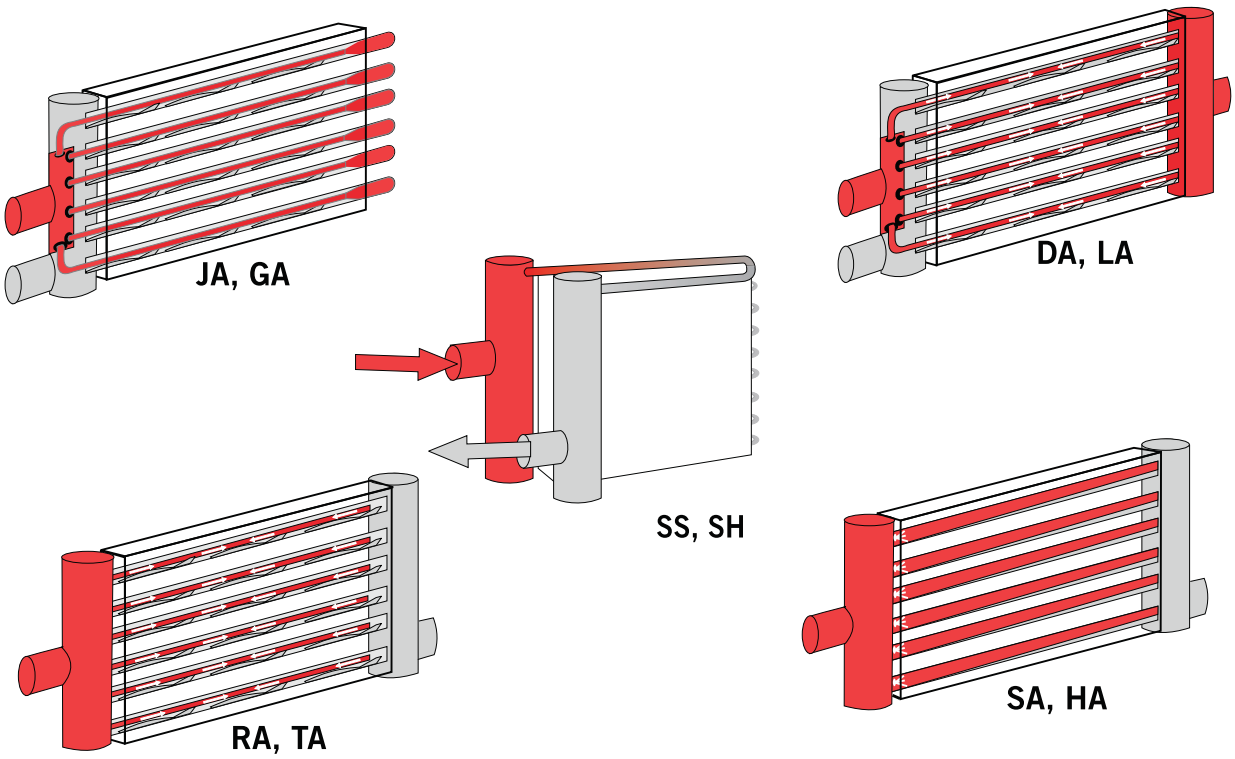
Figure1b - Case Unpitched



Mounting

Steam coils must be properly mounted for condensate removal. This will aid in preventing destructive water-hammer, keeping coils from freezing, and preventing corrosive elements from collecting in the tubes. Case-pitched coils should be installed level as shown in Figure 1a. Models SA, SB, HA, JA, GA, DA, LA, RA and TA come standard pitched in the casing. Models SS and SH utilize return bend construction and are not pitched in the casing, but need to be installed level as in Figure 1a - Case Pitched. Coils that are unpitched, must be installed with the tubes pitched towards the return connection as shown in Figure 1b (with the exception of models SS and SH). A minimum pitch of 0.125" per foot of coil length is required (pitch has been exaggerated in Figure 1b - Case Unpitched for illustration to show a case that was not pitched). Unless otherwise requested, all Heatcraft steam coils shall be case pitched 0.125"/ft as shown in Fig 1a.

Figure 2 - Coil Types



Coil Types

Distributing

Models JA, RA and DA jet-tube steam distributing coils are excellent for any general purpose heating application. With the superior freeze resistance provided by the tube-within-a-tube construction, it is ideal for low temperature preheating and special process applications. The construction features inner tubes with directional orifices to aid in steam distribution and condensate removal. Model JA offers same-end supply and return connections. Model RA offers opposite-end supply and return connections. Model DA offers dual-supply opposite-end connections for long coils that see sub-freezing air temperatures. Models GA, TA and LA utilize cupro-nickel, carbon steel and stainless steel tubing for high-pressure construction.

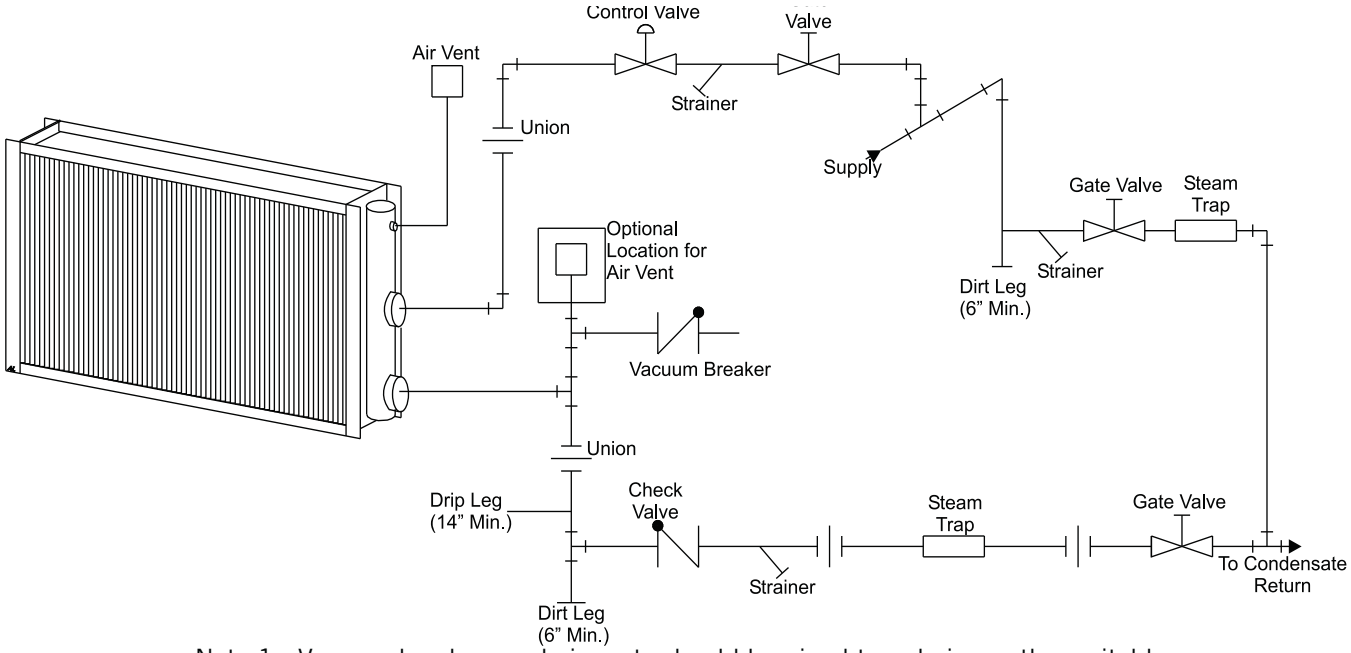
Single Tube

Model SA steam coil is designed for general purpose heating. The construction features a single tube design with opposite-end supply and return connections. A perforated baffle located directly behind the supply connection insures proper steam distribution. Model HA utilizes cupro-nickel, carbon steel and stainless steel tubing for high-pressure construction.

Standard Steam

Model SS steam coil features return-bend construction and same-end connections. Model SH utilizes cupro-nickel, carbon steel and stainless steel tubing for high-pressure construction.

Figure 3 - Steam Coil Piping Diagram



Note 1: Vacuum breakers and air vents should be piped to a drain or other suitable location where discharged steam cannot lead to personal injury.

Installation

1. Carefully remove the coil from the shipping package to avoid damage to the finned surface area. Damaged fins can be straightened using an appropriate fin comb.
2. Heatcraft recommends cleaning the coil with a commercially available coil cleaner prior to installation. Refer to Maintenance on Page 5 for cleaning recommendations.
3. Mount coil properly to insure positive condensate drainage. Refer to Mounting instructions Page 2.
4. Proper clearance should be maintained between the coil and other sturctures such as the fan, filter racks, transition areas, etc.
5. Utilize vacuum breakers on each coil. Steam traps require a positive pressure differential to force the condensate through the valve seat. If the coil's pressure drops below atmospheric, the pressure differential across the valve will be negative and the condensate will not drain. This condition can lead to serious damage or failure of the coil due to freezing, water hammer and corrosion. Refer to piping diagram for recommended placement. See Note 1 in Figure 3 - Steam Coil Piping Diagram on Page 3.
6. Trap each coil separately. Differences in pressure from coil to coil can result in the backing-up of condensate which will result in poor coil performance and possible damage.
7. Provide an air vent for each coil at its highest location. Luvata provides a 0.5" threaded vent connection on the return manifold as a standard on all steam coils. Non-condensable gasses present in the steam will collect in a coil and reduce its capacity. Therefore, it is necessary to provide a means for the removal of these gasses. Also, these gasses can diffuse into the condensate forming byproducts, which can lead to severe corrosion. See Note 1 in Figure 3 - Steam Coil Piping Diagram on Page 3.
8. Steam supply lines need to be drained of condensate. This can be accomplished by the use of drip legs. This ensures that high quality steam enters the coil.
9. Condensate return piping should be the same size as the coil's return connection from the coil outlet to the steam trap.
10. Once installed, the coil should be pressurized to 100 psig with dry nitrogen or other suitable gas. The coil should be left pressurized for a minimum of 10 minutes. If the coil holds the pressure, the field connections can be considered leak free. If the pressure drops by 5 psig or less, re-pressurize the coil and wait another 10 minutes. If the pressure drops again, there are more than likely one or more small leaks, which should be located and repaired. Pressure losses greater than 5 psig would indicate a larger leak, which should be isolated and repaired. Be sure to check valves and fittings as potential sites for leakage or bleed.
11. All field brazing and welding should be performed using high quality materials and an inert gas purge (such as nitrogen) to reduce oxidation of the internal surface of the coil.
12. All field piping must be self supporting. System piping should be flexible enough to allow for thermal expansion and contraction of the coil. The use of flexible connections and/or swing joints is recommended.
13. The coil along with the control valve and trap should be isolated by manual valves to allow for servicing.
14. Refer to Figure 3 - Steam Coil Piping Diagram on Page 3 for general piping.
15. If you are unsure about any portion of the installation, contact your local steam specialist for assistance. Failure to properly install the coil can result in irreparable damage to the coil as well as other components in the system.

Operation

1. Proper airflow distribution is vital to coil performance. Air-flow anywhere on the coil face should not vary by more than 20%.
2. Air velocities should be maintained between 200 and 1500 feet per minute.
3. Operating pressures must be at or below the maximum operating pressure for that coil at the steam temperature. Pressure and temperature limitations can be determined through Luvata's Pressure and Temperature program. Contact your local Luvata coil representative for assistance.

Maintenance

1. Scheduled plant maintenance should include the draining and flushing of the condensate drip legs and sediment traps as well as inspection of condensate traps, vacuum breakers, air vents and valves. Boiler water analysis should also be performed on a regular basis.
2. To continually deliver optimum heating capacity, both the external and internal heat transfer surfaces must be maintained as clean and corrosion free as possible. The finned surface can be maintained by the use and constant inspection of pre-filters. The filters should be replaced as needed.
3. Should the finned surface become fouled, the coil can be cleaned utilizing commercially available coil cleaning fluids. Caution should be exercised in selecting the cleaning solution as well as the cleaning equipment. Improper selection can result in damage to the coil and/or health hazards. Be sure to carefully read and follow the manufacturer's recommendations before using any cleaning fluid. Clean the coil from the leaving air-side so that foreign material will be washed out of the coil rather than pushed further into the coil.
4. Internal coil maintenance consists primarily of preventing scale and corrosion. This is accomplished through aggressive boiler water treatment, removal of dissolved oxygen and the removal of non-condensable gasses such as carbon dioxide.

Note: Boiler water treatment is beyond the scope of this manual. Contact your local water treatment specialist for assistance in establishing a proper boiler-water treatment program.

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Printed in the USA
June 2009

STEAM COIL SPECIFICATION

1.0 GENERAL

Non-distributing steam coils can be used in applications where freeze protection is not a concern. These should be used when entering air temperatures are a minimum of 40°F taking into consideration any outside air dampers being in the incorrect position.

a. Provide separate supports and hangers for the coils and for the piping.
b. Be certain that adequate piping flexibility is provided. Stresses resulting from expansion of closely coupled piping and coil arrangement can cause serious damage. Coils having opposite end connections must be piped with expansion joints.
c. Standard coils are pitched in the casings when installed for horizontal airflow. The installation should be checked to ensure that the casing is level. On vertical airflow applications, the coils must be pitched when installed.
d. Do not reduce pipe size at the coil return connection. Carry return connection size through the dirt pocket, making the reduction at the branch leading to the trap.
e. Install vacuum breakers on all applications to prevent retaining condensate in the coil. Generally, the vacuum breaker is to be connected between the coil outlet and the return main. However, for a system with a flooded return main, the vacuum breaker should be open to the atmosphere and the trap design should allow venting of large quantities of air.
f. Do not drip supply mains through the coil.
g. Do not attempt to lift condensate when using modulating or on-off control.

Traps

a. Size traps in accordance with trap manufacturer's recommendations. Be certain that the required differential will always be available. DO NOT UNDERSIZE.
b. Float and thermostatic or bucket traps are recommended for low-pressure steam. On high-pressure systems, bucket traps are normally recommended. The thermostatic traps should be used only for air venting.
c. Bucket traps are recommended for use with on-off control only.
d. Locate traps at least 12 inches below the coil return connection.
e. Multiple coil installation:
    a. Each coil or group of coils that is individually controlled must be individually trapped.
    b. Coils in series – separate traps are required for each coil, or bank of coils, in series.
    c. Coils in parallel – a single trap may generally be used but an individual trap for each coil is preferred.

Controls

a. With coils arranged for series airflow, a separate control is required on each bank, or coil, in the direction of airflow.
b. On high-pressure installations, a two-position steam valve with a face and bypass arrangement is preferred where modulating control is required.
c. Modulating valves must be sized properly. DO NOT UNDERSIZE.

Freezing Conditions (Entering air temperatures below 35° F)

a. 5JA, 8JA and 8RA coils are recommended.
b. For optimum results, 10 psig steam must be supplied to coils at all times.
c. A minimum of 5 psig is required for proper coil operation.
d. Steam distributing coils should not be used in instances where there is a high condensate load.
e. Modulating valves are not recommended. Control should be by means of face and bypass dampers.
f. Consideration should be given to the use of two or three coils in series with two-position steam control valves on that coil or coils which will be handling 35° F or colder air. The desired degree of control can be attained with a modulating valve on the downstream coil.
g. Provision should always be made to thoroughly mix fresh air and return air before it enters coil. Also, temperature control elements must be properly located to obtain true air mixture temperatures.
h. As additional protection against freeze-up, the trap should be installed sufficiently far below coil to provide an adequate hydrostatic head to help remove of condensate during an interruption in the steam pressure. Estimate 3 feet for each 1 psi of trap differential required.
i. On startup, admit steam to coil ten minutes before admitting outdoor air.

j. Provisions must be made to close fresh air dampers if steam supply pressure falls below minimum specified.

1.1 CERTIFICATION
Acceptable coils are to have ARI Standard 410 certification and bear the ARI symbol. Coils exceeding the scope of the manufacturer's certification and/or the range of ARI's standard rating conditions will be considered provided the manufacturer is a current member of the ARI Air-Cooling and Air-Heating Coils certification program and the coils have been rated in accordance to ARI Standard 410. Manufacturer must be ISO 9002 certified.

1.2 STEAM COIL DESIGN PRESSURES AND TEMPERATURES
Coils shall be designed to withstand 50 psi maximum operating pressures and a maximum steam temperature of 300°F for standard duty copper tube and header coils. Mid pressure coils (50-200 psi) shall be designed with copper tubes and cupronickel headers to withstand 400 degrees. Optional high pressure construction will include cupronickel tubes and headers to increase maximum operating pressure to 350 psi and maximum operating temperature to 450 degrees. Maximum temperatures and pressure can be obtained utilizing an all carbon steel or stainless steel construction. Please call the factory for these applications.

1.3 FACTORY TESTING REQUIREMENTS
Coils shall be submerged in water and tested with a minimum of 315 psi air pressure for standard copper tube coils. A 500 psig hydrostatic and shock test is required for high pressure cupronickel construction. Coils must display a tag with the inspector's identification as proof of testing.

1.4 FINS
Coils shall be of plate fin type construction providing uniform support for all coil tubes. Stainless steel fins shall be constructed of 304 & 316 stainless. Carbon steel fins shall be constructed of ASTM A109-83. Coils are to be manufactured with die-formed aluminum, copper, stainless steel or carbon steel fins with self-spacing collars, which completely cover the entire tube surface. The fin thickness shall be 0.0075 +/- 5% unless otherwise specified. Manufacturer must be capable of providing self-spacing die-formed fins 4 through 14 fins/inch with a tolerance of +/- 4%.

1.5 TUBING
Tubing and return bends shall be constructed from UNS 12200 seamless copper conforming to ASTM B75 and ASTM B251 for standard pressure applications. High pressure construction shall use seamless 90/10 Cupronickel Alloy C70600 per ASTM B111. Stainless steel tubes shall be ASTM A249. Carbon steel tubes shall be W&D - ASTM A214 & seamless - ASTM A179. Copper tube temper shall be light annealed with a maximum grain size of 0.040 mm and a maximum hardness of Rockwell 65 on the 15T scale. Tubes are to be mechanically expanded to form an interference fit with the fin collars. Tubes shall have a nominal thickness of 0.020 inch unless otherwise specified.

1.6 FREE FLOATING CORE
Coils to utilize free floating core assembly to allow for thermal expansion and contraction of tubes during coil operation.

1.7 CLEANING
Prior to brazing, residual manufacturing oils and solid contaminants shall be removed internally and externally by completely submersing the coil in a degreaser, which is chemically compatible with the coil material.

1.8 HEADERS
Headers shall be constructed from UNS 12200 seamless copper conforming to ASTM B75 and ASTM B251 for standard pressure applications. High-pressure construction is to incorporate seamless 90/10 Cupronickel Alloy C70600 per ASTM B111. Stainless steel will be constructed of 304L & 316L (ASTMA312) Sch-5 or Sch-10. Carbon steel headers shall be constructed from Sch-10 (ASTM-A135A) or Sch-40 (ASTM A53A) pipe.

Steam coil return headers are to be equipped with factory-installed 1/2” fpt air vent connection placed at the highest point available on face of the header. Tube-to-header holes are to be intruded inward such that the landed surface area is three times the core tube thickness to provide enhanced header to tube joint integrity. All core tubes shall evenly extend within the inside diameter of the header no more than 0.12 inch. End caps shall be die-formed and installed on the inside diameter of the header such that the landed surface area is three times the

header wall thickness.

1.9 CONNECTIONS
Standard construction fluid connections are male pipe thread (MPT) and constructed from red brass conforming to ASTM B43 or Schedule 40 steel pipe as a minimum. Stainless steel will be 304L or 316L (ASTM-A240) Sch-40 or Sch-80. Carbon steel will be A53A Sch-40, A106A Sch-40 or Sch-80 or A53B Sch-80 pipe.

1.10 BRAZING
High temperature filler metals shall be used for all brazed joints. Filler metal containing at least 5% silver will be used when joining the header to the core tubes. If flux has been used during the brazing process the coil must be steam-cleaned to remove residual fluxes from all internal and external surfaces.

1.10.1 WELDING
Gas shielded arc welding is used for welded vessels constructed of stainless steel. Gas welding is used for welded vessels constructed of carbon steel.

1.11 CASING
Coil casing and endplate shall be fabricated from Galvanized steel, as a standard construction, meeting ASTM and UL G90U requirements, Aluminum, 0.080” thick, optional, Copper, 0.063 “ thick, optional,16- or 14-gauge carbon steel or stainless steel, optional. double-flange casing shall be provided when coils are specified as vertical stacking.

Standard coil intermediate tube sheets (center tube supports) shall be fabricated from the same gauge sheet stock and material as the end plates, and to the following schedule:

Finned Length (inches)	Number of Tube Sheets
6.00 – 48.00	0
48.01 – 96.00	1
96.01 – 144.00	2
144.01 and greater	4

Coils up to 120” finned length should be pitched by manufacturer in case toward condensate connection, a minimum of 1/8” per foot of finned length. Coils over 120” in finned length should be pitched in field to assure proper condensate removal.

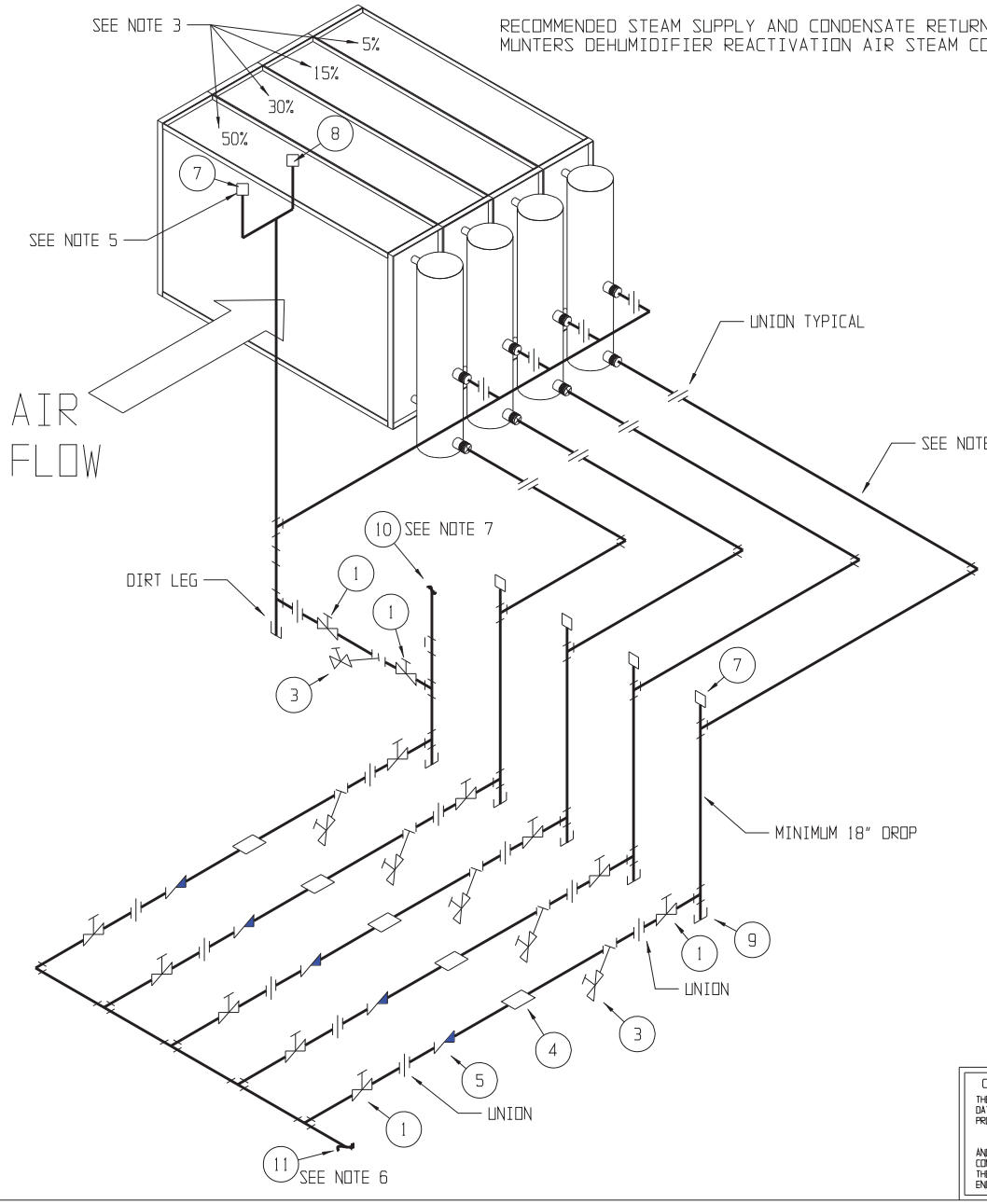
1.12 DELIVERY
Standard lead-time for custom made retrofit steam coils of standard construction with OEM circuiting shall be 11-15 working days, with reduced lead-time emergency shipment options of 10 working days and 5 working days from order placement date and based upon production approval.

Standard lead-time for custom made steam coils of manufacturer’s own standard design and circuiting shall be 10 working days, with reduced lead-time emergency shipment options for 5 working days, 48-hours and 24-hours from order placement date.

All coils shall be quoted and offered as FOB Factory, Full Freight Allowed to any and all destinations within the Continental United States.

1.13 INSTALLATION
Coils to be installed in accordance with manufacturer’s instructions and any applicable piping codes.

RECOMMENDED STEAM SUPPLY AND CONDENSATE RETURN PIPING FOR MUNTERS DEHUMIDIFIER REACTIVATION AIR STEAM COILS



REVISIONS					
REV	ECR	DESCRIPTION	DATE	DFT	CHK	APP
5		REDRAWN TO CADKEY	07/11/95	JEM		SB
6		ADDED WARNING NOTE	07/30/96	CJT	RG	RG
7		CHG. ITEM 4 TO THERMODYNAMIC	07/21/97	CJT	RG	RG
8	810	CHANGED TITLE BLOCK WITH NEW PHONE/FAX NUMBERS	04/22/98	WEM	CJT	RG
9		ADDED NOTE TO WARNING BLOCK, RELOCATED AIR VENT (ITEM 8)	3/22/00	EJL	JT	JT
10		ADDED VARIOUS NOTES AND SHEET 2	8/15/00	CJT	RG	RG
11		ADDED CONCENTRIC REDUCER'S	9/28/01	RPM		
12		REMOVE ITEM 12, CHANGE CPLGS TO UNIONS& DIRT LEG WAS DRIP	02/18/02	BMD	RPM	RG
13		ADDED NOTE 11	10/27/03	DMR	RG	RG

CAUTION:

UNDERSIZING OF PIPING AND TRAPS ON THE CONDENSATE SIDE OF COIL MAY RESULT IN "HAMMERING" AND POTENTIAL STEAM LEAKS. SEE NOTE 3.

LEGEND:

1 - GATE VALVE
2 - WYE STRAINER
3 - BLOW-DOWN VALVE
4 - STEAM TRAP - SEE NOTE 3
5 - CHECK VALVE
6 -
7 - VACUUM BREAKER
8 - AIR VENT
9 - DIRT LEG
10 - STEAM SUPPLY CONNECTION
11 - CONDENSATE RETURN CONNECTION

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All Dimensions Are In Inches Unless Otherwise Specifieded
Tolerances:
Fractions Decimals Angles
± 1/64 ± .005 ± 1/2 Deg.
Finish
Part No. 72164-01

Job No. STD | Date
Customer
Dr.By. BAH 12/87
Ck.By WS 12/87
Aprv.By. WS 12/87

Munters Cargocaire
79 Monroe St. Amesbury, Ma 01913
TEL 978-241-1100 FAX 978-241-1214

PIPING S/A
STEAM REACT

SCALE	SHEET	SIZE		REV
NTS	1 of 2	B	72164	13

NOTES:

1. QUANTITY OF STEAM COILS REQUIRED IS DETERMINED BY STEAM PRESSURE AVAILABLE, AND REACTIVATION ENERGY REQUIRED.

2. THESE RECOMMENDATIONS ARE FOR GUIDANCE ONLY. IT IS RECOMMENDED THAT THE CUSTOMER CONSULT A STEAM PIPING CONSULTANT FOR SPECIAL REQUIREMENTS.

3. CONDENSATE PIPIING AND TRAPS TO BE SIZED PER TRAP MANUFACTURERS SPECIFICATION. COILS TO BE INDIVIDUALLY TRAPPED. THE CONDENSATE LOAD OF EACH COIL IS A PERCENTAGE OF THE TOTAL CONDENSATE LOAD. THE APPROXIMATE PERCENTAGE OF CONDENSATE LOAD FOR EACH COIL IS SHOWN ON SHEET 1. SIZE CONDENSATE TRAPS ACCORDINGLY.

4. CONDENSATE LINES TO BE SAME SIZE AS CONDENSATE CONNECTION ON COIL. REDUCE LINE SIZE AT TRAP USING AN ECCENTRIC REDUCER.

5. AIR VENTS AND VACUUM BREAKERS TO BE HIGHER THAN THE STEAM SUPPLY CONNECTION.

6. CONDENSATE IS TO DRAIN TO A GRAVITY SYSTEM.
   NO BACK PRESSURE ALLOWED. THERMODYNAMIC TRAPS ARE RECOMMENDED.

7. DO NOT INSTALL MODULATING STEAM VALVE ON COILS. ENERGY MODULATION IS ACHIEVED BY MODULATING AIRFLOW ACROSS COILS. (REFER TO SEQUENCE OF OPERATION). INSTALLATION OF A MODULATING VALVE MAY CAUSE DAMAGE TO STEAM COILS AND MAY VOID WARRANTY.

8. IF SUPPLY VALVE IS USED, IT SHOULD BE SLOW ACTING AND SHOULD BE CLOSED ONLY DURING SYSTEM SHUTDOWN AND WIDE OPEN AT ALL OTHER TIMES.

9. COILS MUST BE INSTALLED LEVEL TO ASSURE PROPER CONDENSATE DRAINAGE.

10. DRAWING SHOWN REPRESENTS HORIZONTAL TUBES FOR VERTICAL TUBE COILS, PIPING REMAINS THE SAME; SUPPLY HEADERS ARE ON TOP OF THE COIL AND CONDENSATE HEATERS ARE ON THE BOTTOM OF THE COIL.

11. SCHEDULE 80 PIPING RECOMMENDED.

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All Dimensions Are In Inches Unless Otherwise Specifieded	Job No. STD		Date
Tolerances:	Customer		
Fractions Decimals Angles ± 1/64 ± .005 ± 1/2 Deg.	Dr.By. BAH	12/87	
Finish	Ck.By MS	12/87	
Part No. 72164-01	Aprv.By. MS	12/87	

Munters Cargocaire
79 Monroe St. Amesbury, Ma 01913
TEL 978-241-1100 FAX 978-241-1214

PIPING S/A
STEAM REACT

SCALE	SHEET	SIZE		REV
NTS	2 of 2	B	72164	13

Certificate of Registration

nqa global assurance

This is to certify that the Quality Management System of

Munters Cargocaire
Cargocaire Engineering Corporation
79 Monroe Street
Amesbury, MA 01913

applicable to:

Design, manufacture and after sales service of industrial dehumidifiers and air handling systems

has been assessed and registered by
NQA against the provisions of

BS EN ISO 9001:2008

This registration is subject to the company maintaining a quality management system, to the above standard, which will be monitored by NQA

Head of NQA

UKAS QUALITY MANAGEMENT 015

Certificate Number:	6884
EAC Code:	18
First Issued:	26 October 1993
Valid Until:	25 July 2014
Reissued:	25 July 2011

The use of the UKAS Accreditation Mark indicates accreditation in respect of those activities covered by the accreditation certificate number 015 held by NQA.
NQA is a trading division of Ascertiva Group Ltd, Registration No. 02513162. Registered Office: Warwick House, Houghton Hall Park, Houghton Regis, Dunstable LU5 5ZX

This certificate is the property of National Quality Assurance Limited and must be returned on request.

Certificate of Registration

nqa global assurance

This is to certify that the Quality Management System of

Munters Cargocaire
Munters Zeol
79 Monroe Street
Amesbury, MA 01913

applicable to:

Design, manufacture and after sales service of V.O.C. abatement systems

has been assessed and registered by
NQA against the provisions of

BS EN ISO 9001:2008

This registration is subject to the company maintaining a quality management system, to the above standard, which will be monitored by NQA

Head of NQA

UKAS QUALITY MANAGEMENT 015

Certificate Number:	6884/1
EAC Code:	18
First Issued:	11 October 1995
Valid Until:	25 July 2014
Reissued:	25 July 2011

The use of the UKAS Accreditation Mark indicates accreditation in respect of those activities covered by the accreditation certificate number 015 held by NQA.
NQA is a trading division of Ascertiva Group Ltd, Registration No. 02513162. Registered Office: Warwick House, Houghton Hall Park, Houghton Regis, Dunstable LU5 5ZX

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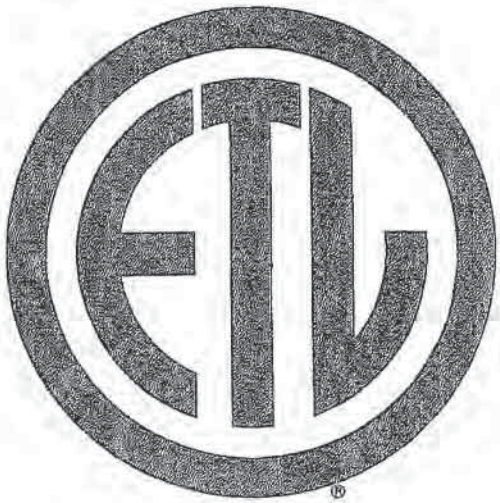


SINCE 1896

ETL Testing Laboratories, Inc.

ETL is an independent testing laboratory with more than 90 years of operating experience.

26994

REPORT
ETL TESTING LABORATORIES, INC.

INDUSTRIAL PARK CORTLAND, NEW YORK 13045

ORDER NO. 66409-214 DATE: 06/04/92

ASTM E84-90
SURFACE BURNING
CHARACTERISTICS OF
BUILDING MATERIALS

Report No. 518334

Rendered To:

MUNTERS CARGOCAIRE ENGINEERING CORP.
79 MONROE STREET
AMESBURY, MA 01913

All services undertaken subject to the following general policy: Reports are submitted for exclusive use of the clients to whom they are addressed. Their significance is subject to the adequacy and representative character of the samples and to the comprehensiveness of the tests, examinations or surveys made. No quotations from reports or use of ETL's name is permitted except as expressly authorized by ETL in writing.

ABSTRACT

The Honeycombe® Wheel, Manufactured by Munters Cargocaire Engineering Corp. was evaluated in accordance with the requirements of ASTM E84-90 Standard Test method for Surface Burning Characteristics of Building Materials on 06/02/92.

TEST SPECIMEN	FLAME SPREAD INDEX 0	SMOKE DEVELOPED INDEX 10

Equipment	Model	Control No.	Calibration Date
Steiner Tunnel	ETL 1	n/a	n/a
Manometer 10 inch	826SPRO	F142	10/18/91
Manometer 0.25 inch	826SPRO	F143	10/25/91
Manometer Gage 0.25 inch	2000-00	F140	10/25/91
Manometer Gage 1 inch	4302	F145	11/29/91
Pressure Gage 30 psi	FLUFIL	F144	11/30/91
Nullmatic Controller	524T2	F141	11/30/91
TC Indicator	199AKFX	T449	10/18/91
TC Indicator	199AKFX	T450	10/18/91
Chart Recorder	2503000	T451	10/18/91
Ammeter 5 ADC	2123	A142	10/21/91
Voltmeter 15 VDC Serial No.	V203	V203	10/21/91

INTRODUCTION

This report describes the results of the ASTM E84-90 Standard Method of Test for Surface Burning Characteristics of Building Materials performed on specimens of a Honeycombe® Wheel submitted by Munters Cargocaire Engineering Corp. The test evaluations were conducted by ETL Testing Laboratories, Incorporated.

The purpose of the method is to determine the relative burning behavior of the material by observing the flame spread along the specimen. Flame spread and smoke density developed are reported, however, there is not necessarily a relationship between these two measurements.

The use of supporting materials on the underside of the test specimen may lower the flame spread index from that which might be obtained if the specimen could be tested without such support. This method may not be appropriate for obtaining comparative surface burning behavior of some cellular plastic materials. Testing of materials that melt, drip, or delaminate to such a degree that the continuity of the flame front is destroyed, results in low flame spread indices that do not relate directly to indices obtained by testing materials that remain in place.

This test method is also published under the following designations:

ANSI 2.5	UBC 42-1
NFPA 255	UL 723

This standard should be used to measure and describe the properties of materials, products, or assemblies in response to heat and flame under controlled laboratory conditions and should not be used to describe or appraise the fire hazard or fire risk of materials, products, or assemblies under actual fire conditions. However, results of this test may be used as elements of a fire risk assessment which takes into account all of the factors which are pertinent to an assessment of the fire hazard of a particular end use.

TEST OBJECTIVE

The ASTM E84-90 (25 foot tunnel) test method is intended to compare the surface flamespread and smoke developed measurements to those obtained from the tests of mineral fiber cement board and select grade red oak flooring. The test specimen surface (18 inches wide and 24 feet long) is exposed to a flaming fire exposure (adjusted to cause a 25 foot spread of flame along a red oak calibration specimen in 5.5 minutes) during the 10 minute test duration, while flamespread over its surface and density of the resulting smoke are measured and recorded. Test results are presented as the computed comparisons to the standard calibration materials. The mineral fiber cement board forms the zero point, while the red oak flooring is set as 100 for smoke measurements. Thus, with a relative zero established by the non-combustible cement board, all test specimens are compared to select grade red oak flooring, and the results expressed as Flame Spread Index and Smoke Developed Index.

AUTHORIZATION

The test was authorized by Munters Cargocaire Engineering Corp. Purchase Order No. M925228 dated 05/26/92.

DESCRIPTION OF TEST SPECIMENS

The test specimens were prepared at ETL Testing Laboratories, Inc., from samples forwarded by Munters Cargocaire Engineering Corp.

Specimen Identification: Honeycombe® Wheel

Date Received:	05/28/92
Date Prepared:	06/02/92
Date Tested:	06/02/92
Conditioning (73°F & 50% R.H.):	2 Days
Specimen Width (in):	24
Specimen Length (ft):	24
Specimen Thickness (in):	.098
Entire Specimen Weight (lb):	5.5
Application Rate:	n/a

MOUNTING METHOD: The specimen was placed on 2 inch galvanized hexagonal wire mesh which was supported on 3/16 inch round metal rods spaced 2 feet apart throughout the length of the tunnel.

TEST PROCEDURE

The test specimens were placed in the tunnel and supported over the tunnel ledges. The specimen was overlapped 2 inches. The sample was conducted in accordance with the published test method on 06/02/92.

TEST RESULTS

The test results, computed on the basis of observed flame front advance electronic smoke density measurements are presented in the following table. In recognition of possible variations and limitations of the test method, the results are computed to the nearest number divisible by five, as outlined in the test method.

While no longer a part of this standard test method, the Fuel Contributed Value has been computed, and may be found on the computer printout sheet.

TEST SPECIMEN	FLAME SPREAD INDEX	SMOKE DEVELOPED INDEX
Mineral Fiber/Cement Board	0	0
Red Oak Flooring	100	100
Honeycombe® Wheel	0	10

OBSERVATIONS

The specimen exhibited steady ignition at 24 seconds. There was no flame spread observed. After the ignition flame was extinguished, the specimen did not continue to flame.

These data sheets which follow are actual print-outs of the computerized data system which monitors the ASTM E84 furnace.

ASTM E84-90 DATA SHEET

CLIENT: Munters Cargocaire Engineering Corp.
DATE: 06/02/92
TEST NUMBER: 1
ORDER NUMBER: 66409-214
OPERATOR: Amy L. Rice
MATERIAL ID: Honeycombe® Wheel

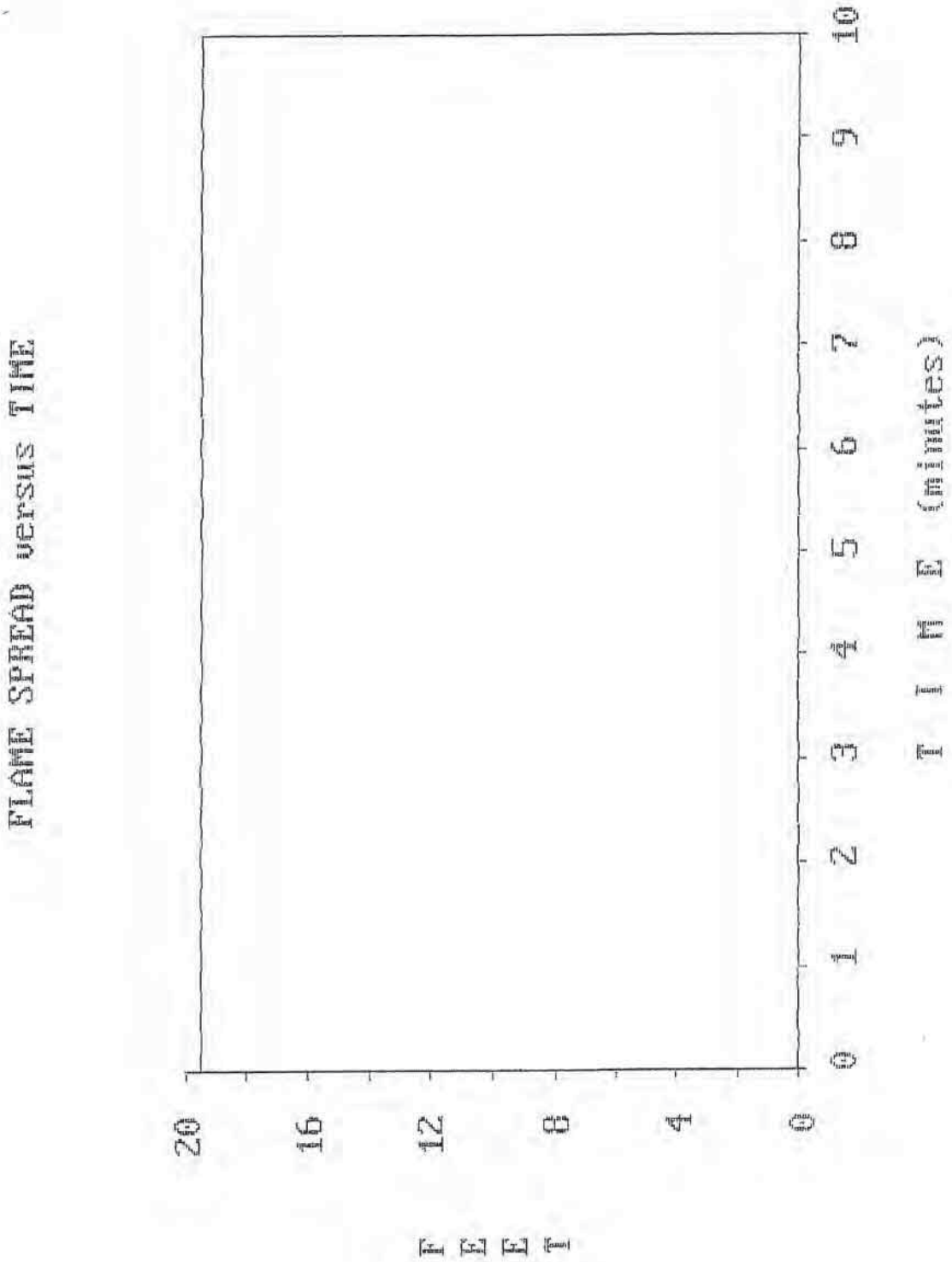
FLAMESPREAD INDEX = 0
SMOKE DEVELOPED INDEX = 10

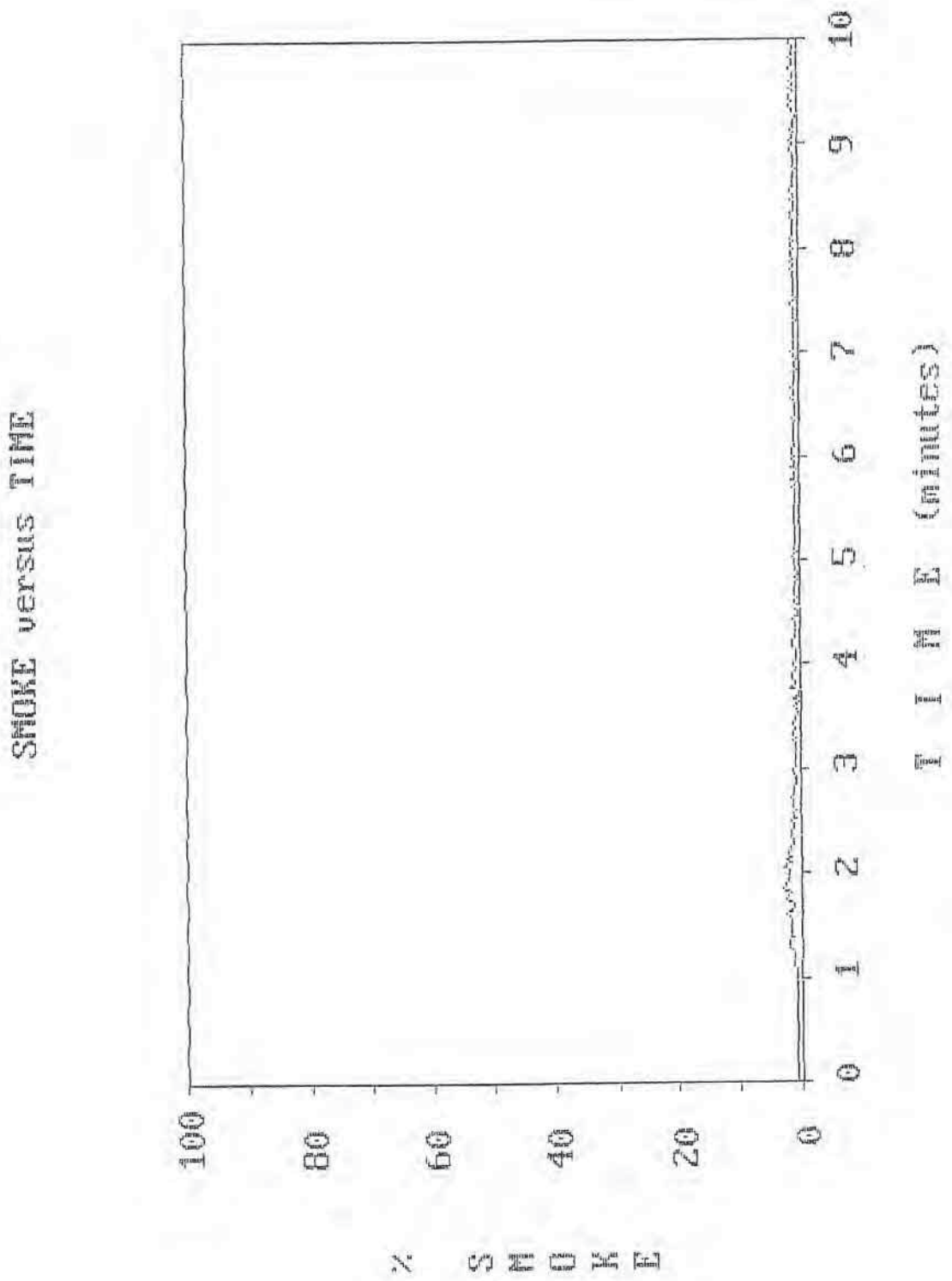
SPECIMEN DATA . . .

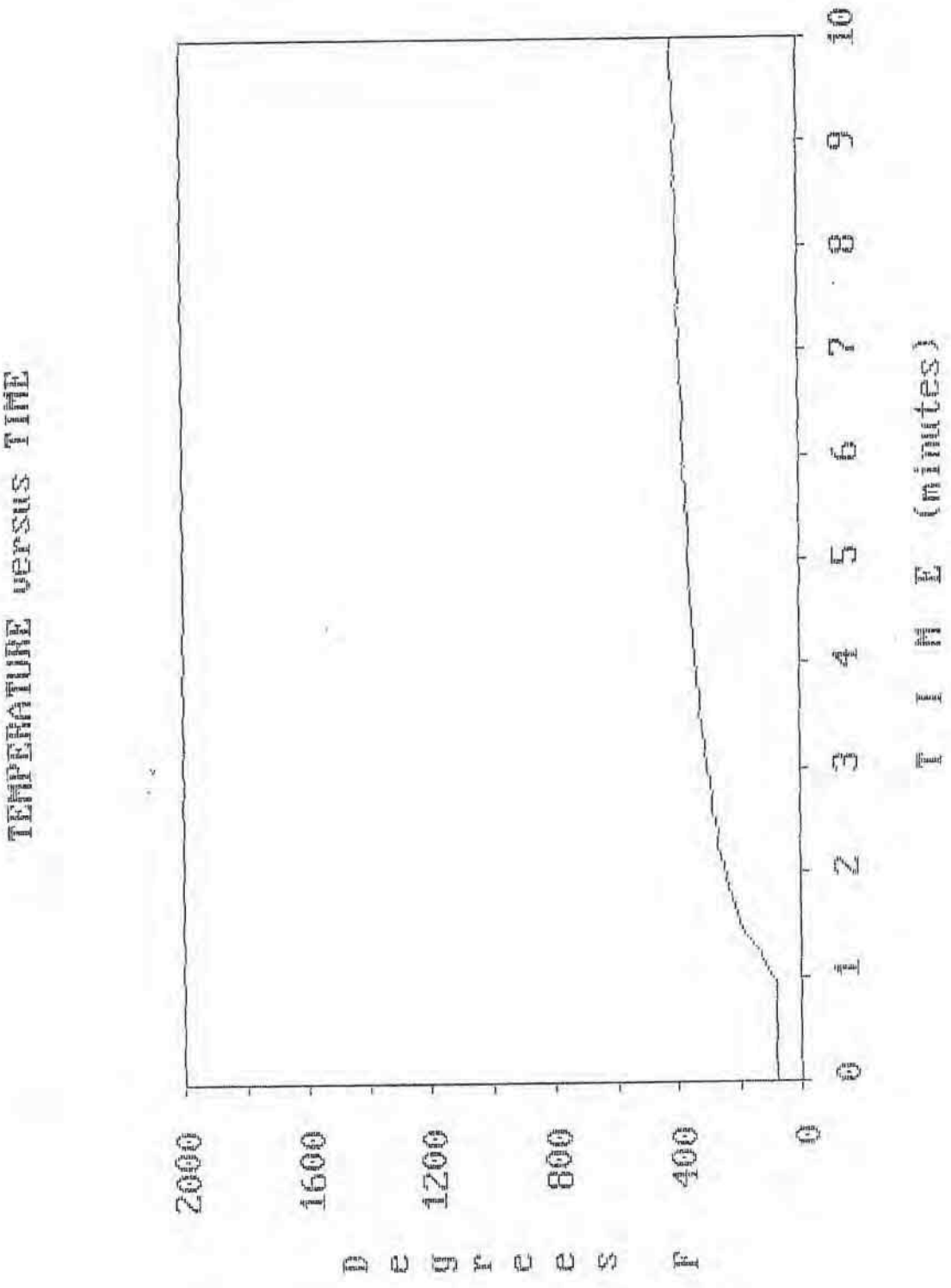
	Test Specimen	Red Oak
Time To Ignition (min:sec):	00:24	00:37
Time To Max. Flame Spread (min:sec):	n/a	
Max. Flame Spread (ft):	n/a	
Max. Temperature (Deg. F):	411	
Time To Max. Temperature (min:sec):	09:54	
Time To 980 Degrees F (min:sec):	n/a	
Flame Spread x Time Area (min*ft):	0	
Smoke x Time Area (min*%T):	12	97
Temperature x Time Area (min*Deg.F):	3169	9778
Unrounded Flame Spread Index:	0.00	
Unrounded Smoke Developed Index:	12.07	

Total Fuel (natural gas) Consumed (ft^3): 42.51

Temperature x Time
Area for GRC Board (min*Deg.F): 4842


FLAME SPREAD VERSUS TIME
FEET
20
16
12
8
4
0
0 1 2 3 4 5 6 7 8 9 10
TIME (minutes)


SMOKE versus TIME
% SMOKE
100
80
60
40
20
0
0 1 2 3 4 5 6 7 8 9 10
TIME (minutes)


TEMPERATURE VERSUS TIME
Degrees F
2000
1600
1200
800
400
0
0 1 2 3 4 5 6 7 8 9 10
Time (minutes)

CONCLUSION

The Honeycombe® Wheel submitted by Munters Cargocaire Engineering Corp. and previously described, when tested in accordance with ASTM E84-90 Standard Test Method for Surface Burning Characteristics of Building Materials, on 06/02/92 achieved the following results:

FLAME SPREAD INDEX	0	SMOKE DEVELOPED INDEX	10

Signed:

Amy L. Rice
Technician
Fire/Flammability Dept.
Safety Group

Reviewed and Approved:

Nigel R. Stamp.
Manager
Fire/Flammability Dept.
Safety Group

ALR/amg

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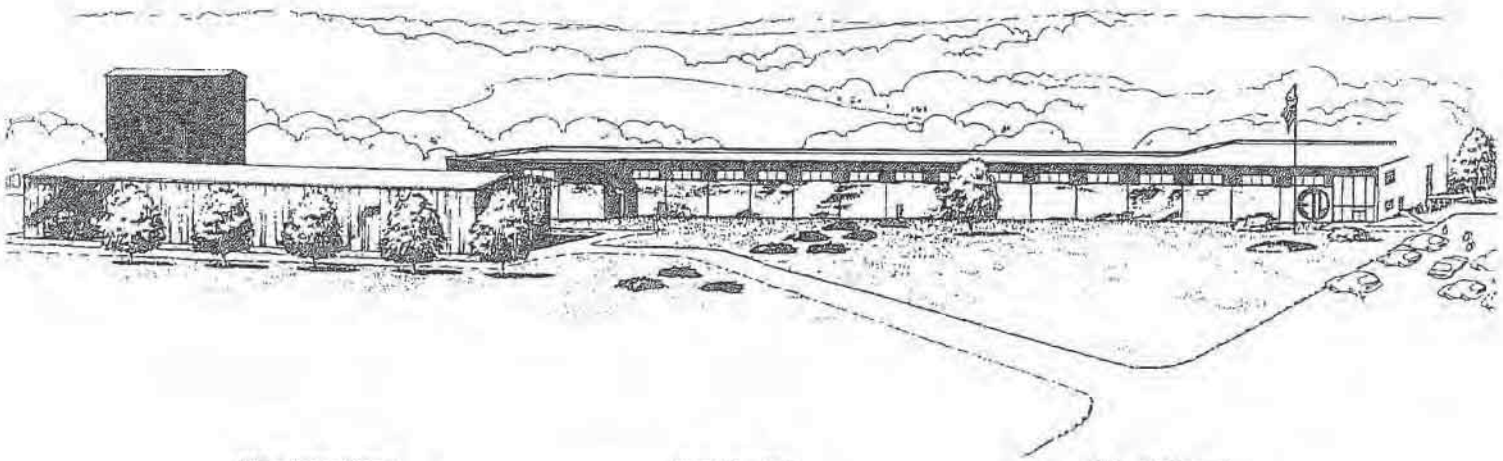
- acoustical
- air-conditioning and refrigeration
- carpet
- fire/flammability
- sanitation
- electrical/electronic
- mechanical/environmental
- photometric
- product certification and validation for industrial groups
- product safety
- gas appliances



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Kowloon, Hong Kong
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FAX: 7855487

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FAX: 5958645

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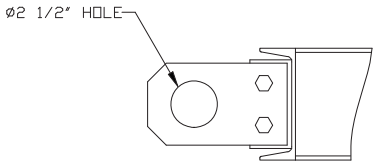
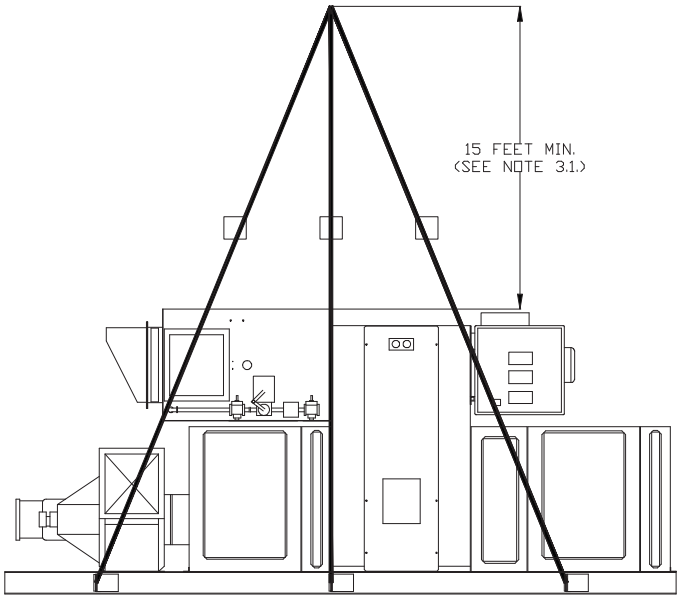
End 26994

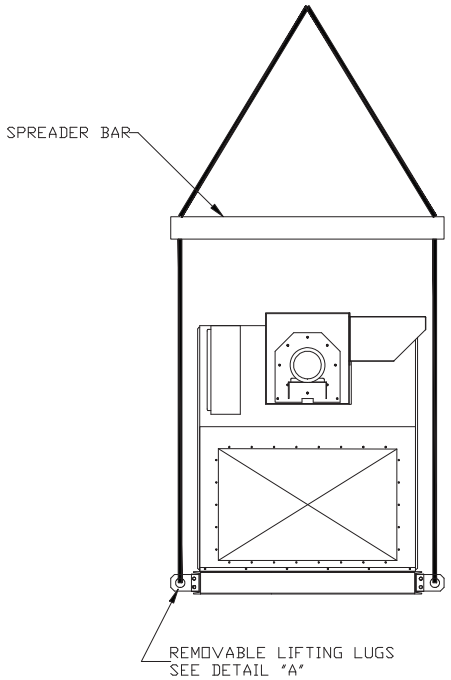
Revisions					
Rev	Description	Date	Dft	Chk	App
1	CONVERTED TO CAD FROM PDF, MODIFIED NOTES	12/11/09	MRB	EJL	EJL



DETAIL 'A'



FRONT ELEVATION



END ELEVATION

NOTES:

1. RECEIVING: WHEN EQUIPMENT IS RECEIVED ALL ITEMS SHOULD BE CAREFULLY CHECKED AGAINST THE BILL OF LADING TO BE SURE THAT THE TOTAL NUMBER OF PIECES HAVE BEEN RECEIVED, THE SYSTEM WAS THOROUGHLY INSPECTED BEFORE LEAVING THE FACTORY AND THE CARRIER HAS ACCEPTED AND SIGNED FOR IT. ANY DAMAGE OR IRREGULARITIES SHOULD BE NOTED TO THE CARRIER.
2. HANDLING & RIGGING;
   - 2.1. WHEN LIFTING AN HCD SYSTEM FROM A FLAT BED TRUCK OR A FLAT CAR WITH A HOOK AT A SINGLE POINT, A LIFTING/SPREADING DEVICE SIMILAR TO THE ONE SHOWN IS SUGGESTED.
   - 2.2. THE LIFTING/SPREADING DEVICE AND LIFTING BARS MUST BE FURNISHED BY THE RIGGING CONTRACTOR AND MUNTERS ASSUMES NO RESPONSIBILITY OR LIABILITY FOR METHODS OR MATERIALS USED. LIFTING/SPREADING DEVICE MUST BE CAPABLE OF LIFTING THE TOTAL SYSTEM WEIGHT (REFER TO GENERAL ARRANGEMENT FOR APPROXIMATE WEIGHT).
   - 2.3. A LIFTING/SPREADING DEVICE IS ESSENTIAL TO PREVENT CRUSHING SYSTEM SIDES AND DAMAGE TO SENSITIVE CONTROL COMPONENTS.
   - 2.4. RIGGING MUST BE DESIGNED SO THAT LOAD REMAINS LEVEL AT ALL TIMES.
3. LIFTING:
   - 3.1. RECOMMENDED LIFTING/SPREADING DEVICE SHOULD HAVE A LENGTH SUFFICIENT TO PREVENT THE CABLES FROM DAMAGING THE EQUIPMENT. THE WIDTH SHALL NOT EXCEED 18 INCHES WIDER THAN THE WIDTH OF THE LIFTING LUGS HOLE CENTER TO CENTER DISTANCE AS VIEWED FROM THE END ELEVATION. ALL LIFTING LUGS ARE TO BE UTILIZED. CABLES MUST BE LONG ENOUGH TO PERMIT A MINIMUM DISTANCE OF 15 FEET BETWEEN CABLE CENTER RING AND HIGHEST POINT OF THE SYSTEM.
   - 3.2. SAFETY LINES SHOULD BE ATTACHED TO SKID AT NOT LESS THAN 2 POINTS TO PREVENT SWINGING OR TWISTING DURING LIFTING.
   - 3.3. PRIOR TO LIFTING, CHECK THAT ALL ACCESS PANELS ARE IN PLACE, THAT CORNERS ALONG TOP SURFACES ARE PROTECTED FROM POSSIBLE DAMAGE BY SLINGS AND THAT ALL EXPOSED COMPONENTS ARE FULLY PROTECTED.
   - 3.4. LIFTING SHOULD BE ACCOMPLISHED USING SAFEST SPEED OF LIFT BASED ON CONDITIONS AT TIME OF OPERATION.
   - 3.5. WHEN A SYSTEM IS SPLIT INTO TWO OR MORE SECTIONS, EACH SECTION IS TO BE LIFTED INDIVIDUALLY AS SHOWN. DO NOT LIFT A "SPLIT SYSTEM" AS A COMPLETE UNIT.
4. PLACEMENT:
   - 4.1. THE HCD SYSTEM IS DESIGNED TO BE PLACED AS A SINGLE STRUCTURE ON A CONCRETE PAD OR OTHER TYPE OF SUPPORTING BASE DESIGNED FOR SUPPORTING THE WEIGHT OF THE SYSTEM.
   - 4.2. THE SYSTEM SHOULD BE PLACED AS TO ALLOW ACCESS TO ALL COMPONENTS AND EQUIPMENT. CARE SHOULD BE TAKEN SO THAT AIR INLETS AND OUTLETS ARE NOT BLOCKED BY OTHER STRUCTURES OR PIECES OF EQUIPMENT THAT DO NO INTERFACE WITH THE SYSTEM.
   - 4.3. THE SYSTEM MUST BE LOWERED GENTLY ONTO THE BASE OR SUPPORT STRUCTURE WITHOUT BOUNCING OR DROPPING.
   - 4.4. CARE MUST BE TAKEN DURING PLACEMENT OF UNIT WITH REGARD TO AVAILABILITY OF UTILITIES.

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Job No.	STANDARD	
Customer		
Dr.By.	D. REILLY	4/23/97
Ck.By	RG	4/97
Aprv.By.	RG	4/97

Munters Corporation
79 Monroe St. Amesbury, Ma. 01913
TEL 978-241-1100 FAX 978-241-1214

RIGGING INSTRUCTIONS
HCD SYSTEMS

SCALE	SHEET	SIZE		REV
NTS	1 of 1	B	27137	1

9
Calculations - Pressure Drop

Buffalo Air Handling, Pressure Drop Program
Results Page

Version 3.0d

Program User Name:	DL
Date:	12/14/2012
Order Number:	130079-01
Mark:	TCS41704A/AHU00407
Customer Name:	Thomas Engineering Inc.
Engineer:	Thomas Engineering Inc.
Design AirFlow (CFM):	1700
Fan Quantity:	1
Additional Information:	Rev A with HEPA filters removed

Upstream External Losses (in. W.G.): 1.25
Downstream External Losses (in. W.G.): 3.75

**NOTE: A pressure drop value followed by "*" indicates a user defined value.*

UpStream Components

Face Velocity	Pressure Drop	Component
1133	0.04	Inlet - Wall or Ceiling, Damper
425	1.00	Filter - 2" Pleated, Cleanliness = Dirty
425	1.50	Filter - 12" Rigid, 95%, Cleanliness = Dirty
387	0.02*	Heating Coil - Standard, Spiral Fin, 1 Row
314	0.65*	Cooling Coil - Plate, 12 Rows
300	0.01	Damper - Airfoil
300	1.10*	Special Component, Desiccant Dehumidifier

Section Total	4.32	

Fan Components

Face Velocity	Pressure Drop	Component
	0.07	Arrangement/Class 3 reduction
	0.02	Belt guard reduction
	0.04	Inlet screen reduction
	0.03	Clearance ratio reduction, 0.9 dia.
	0.22	Fan Extra Pressure

1587	0.38	Fan - Supply, Centrifugal, SWSI Arrangement 3, 15.00 Wheel dia.

DownStream Components

Face Velocity	Pressure Drop	Component
1587	0.14	Diffuser - Full Size, 6.3" from fan
571	0.01	Damper - Airfoil
571	0.64*	Cooling Coil - Plate, 6 Rows
500	0.01	Humidifier - Panel

Section Total	0.80	

Summary

Fan Static Pressure = 10.50

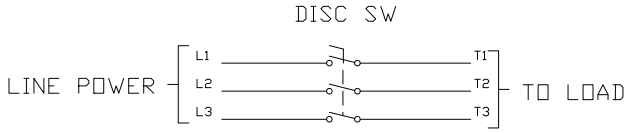
Total Internal Losses (in. W.G.): 5.50
Total External Losses (in. W.G.): 5.00

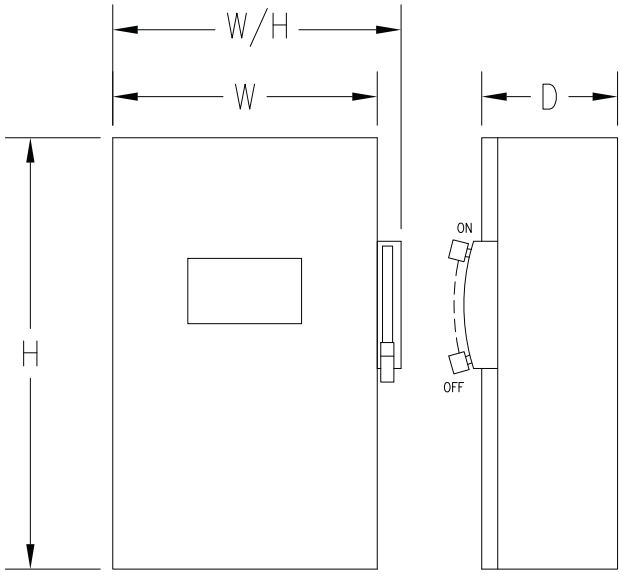
Total: 10.50

(Extra Static Pressure = 0.22, Fan Section)

10
Electrical & Test Procedures

ES-7203





ES ITEM NO.	SWITCH RATING AMP.	MAX. H.P.		H	W	D	W/H	APPROX WT. LBS.
		230V	460V					
-1	30	10	20	14.9	6.70	4.90	7.60	11.0
-2	60	20	50	17.5	9.00	6.40	10.5	16.0
-3	100	40	75	21.3	8.50	6.40	10.5	17.0
-4	200	60	125	27.4	13.2	7.50	14.8	34.0
-5	400	125	250	50.3	27.9	10.2	27.9	112.0

575-600V 60Hz - AVAILABLE, HOWEVER HP RATINGS MAY VARY (CONSULT FACTORY)
200-208V 60Hz - AVAILABLE AT REDUCED HORSEPOWER RATINGS (CONSULT FACTORY).
SUITABLE FOR 50 Hz APPLICATIONS, HOWEVER HP RATINGS MAY VARY (CONSULT FACTORY)

MOUNTING:
MOUNTED INSIDE OR OUTSIDE OF UNIT NEXT TO THE COMPONENT BEING SWITCHED.

HEIGHT MUST NOT EXCEED 60" FROM TOP OF HANDLE IN HIGHEST POSITION TO SURFACE ON WHICH OPERATOR WILL STAND WHEN OPERATING DISCONNECT HANDLE. THIS SURFACE WILL BE THE FLOOR OF THE UNIT IF MOUNTED INTERNALLY, AND THE BOTTOM OF THE CHANNEL BASE IF MOUNTED EXTERNALLY, UNLESS OTHERWISE NOTED.

HEAVY DUTY, NON-FUSED DISCONNECT SWITCH
THREE-POLE 600VAC, 250VDC

AUXILIARY CONTACT KITS AVAILABLE

REFERENCE ES-7110 FOR WIRING COLORS

NEMA 3R - OUTDOOR ENCLOSURE
TO PROVIDE A DEGREE OF PROTECTION AGAINST FALLING RAIN AND SLEET UNDAMAGED BY FORMATION OF ICE ON ENCLOSURE.

REV.		
A	J.S.	11/25/08
1. ADD LAST NOT AT THE BOTTOM		

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NAME: G.K.

APPROVED:

Buffalo Air Handling

TITLE: NEMA 3R - OUTDOOR ENCLOSURE SAFETY SWITCH\DISCONNECT

DATE: 08/09/01

PAGE 1 OF 1

ES-7203

Factory Vibration Test Procedure

Introduction

This report outlines the test procedure to be used in the vibration evaluation of a production air-handling unit fan. The test will be conducted at the factory of Buffalo Air Handling. The test forms the basis for product qualification or acceptance criteria as established in accordance with ANSI/AMCA Standard 204-05, Balance Quality and Vibration Levels for Fans.

Scope

A completed air handling unit with a fan which has been aligned, balanced and in which there is no looseness will be run at design speed and as close as practical to the design pressure.

Test Procedure

A vibration analyzer, Commtest Model VB8 or equal, will be used to measure the vibration levels in velocity (in/sec peak). The readings will be taken in the horizontal, axial (where accessible) and vertical direction on the housing of fan and motor bearings. When safe access is not available, as on direct driven axial fans, the vibration readings shall be taken on the fan housing adjacent to the motor bearings. All readings shall be reported in tabular form.

Acceptance Criteria

Acceptance is based upon ANSI/AMCA Standard 204-05, which specifies the peak vibration limit for fan tests conducted at the factory. A function of this acceptance criteria is whether the equipment is mounted upon fixed (rigid) supports or on spring isolators (flexible) supports.

Fan applications are sub-divided into balance and vibration categories BV-1 through BV-5. The balance and vibration category divisions reflect their application and drive power to arrive at appropriate balance and vibration (BV) levels as defined in ANSI/AMCA Standard 204-05. Those vibration levels for air-handling unit fans are as follows:

Application Factory, Filter-in	Driver Horsepower	Fan Application Category, BV	Rigid Mounting (in/sec)	Flexible Mounting (in/sec)
HVAC	≤ 5.0	BV-2	0.20	0.30
	> 5.0	BV-3	0.15	0.20

Buffalo Air Handling flexible mounting fan vibration acceptance criteria have been established at levels below the AMCA tolerance. Those factory test vibration levels are as follows.

Application Factory, Filter-in	Driver Horsepower	Fan Application Category, BV	Rigid Mounting (in/sec)	Flexible Mounting (in/sec)
HVAC	≤ 5.0	BV-2	0.16	0.16
	> 5.0	BV-3	0.15	0.16

REV.		
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B	1. CHANGED TITLE BLOCK LOGO.	1/22/10
C	1. MINOR APPROVAL EDITING.	5/10/10

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REFERENCE:

TITLE: Factory Vibration Test

DRAWING STATUS: Complete

DESIGNER: D.M. /T.R.K.

APPROVED BY: TRK

DATE: 7/22/09

PAGE: 1 of 4

BUFFALO AIR HANDLING

DRAWING NO. (REF. JO#): ES-8107

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Buffalo Air Handling Company will monitor the "overall" "filter-out" vibration levels at each location to check possible vibration sources other than balance. Overall vibration levels shall not exceed those stated below and will not be reported.

Application Factory, Filter-out	Driver Horsepower	Fan Application Category, BV	Rigid Mounting (in/sec)	Flexible Mounting (in/sec)
HVAC	≤ 5.0	BV-2	0.25	0.30
	> 5.0	BV-3	0.20	0.30

The field (*in-situ*) fan vibration level is not the responsibility of Buffalo Air Handling unless specified in the purchase contract and agreed to by Buffalo Air Handling. ANSI/AMCA 204-5 does not designate "filter-in" field fan vibration levels.

When verification of fan balance in the field is provided by Buffalo Air Handling the acceptance criteria shall be "filter-in" factory level as stated in ANSI/AMCA 204-5. Those vibration levels are as stated below.

Application Start-up, Filter-in	Driver Horsepower	Fan Application Category, BV	Rigid Mounting (in/sec)	Flexible Mounting (in/sec)
HVAC	≤ 5.0	BV-2	0.20	0.30
	> 5.0	BV-3	0.15	0.20

ANSI/AMCA 204-5 does designate field "filter-out" fan vibration levels. Buffalo Air Handling shall verify that the fan vibration levels are below ANSI/AMCA 204-5. Overall field "filter-out" vibration levels will not reported.

Application Start-up, Filter-out	Driver Horsepower	Fan Application Category, BV	Rigid Mounting (in/sec)	Flexible Mounting (in/sec)
HVAC	≤ 5.0	BV-2	0.30	0.50
	> 5.0	BV-3	0.25	0.35

When required and accepted by Buffalo Air Handling Company a velocity spectrum may be provided for the range of 0-200Hz (0-120,000 cpm) at the fan operating speed. A velocity spectrum analysis is not part of the standard vibration test.

Prior to acceptance of an order Buffalo Air Handling must review vibration criteria in addition to or exceeding those stated above.

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PAGE: 2 of 4

BUFFALO AIR HANDLING

DRAWING NO. (REF. JO#): ES-8107

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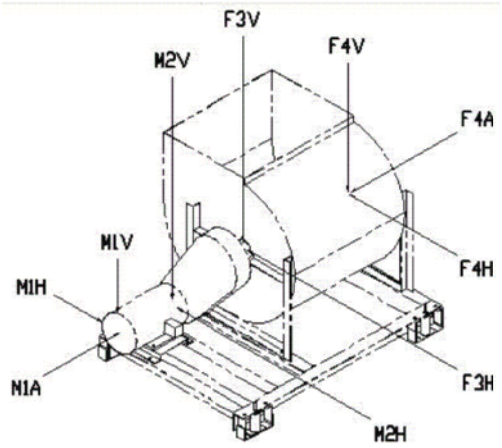
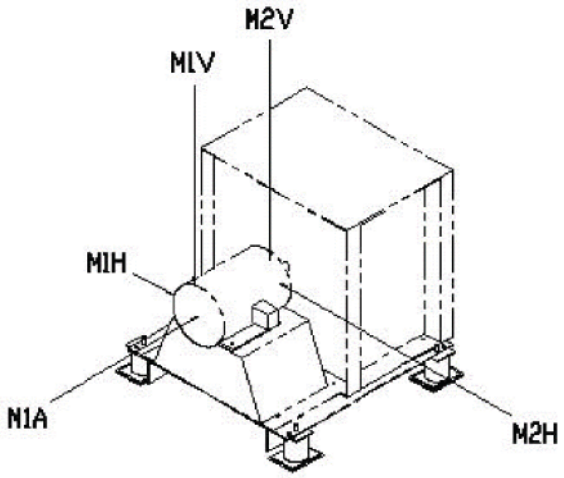
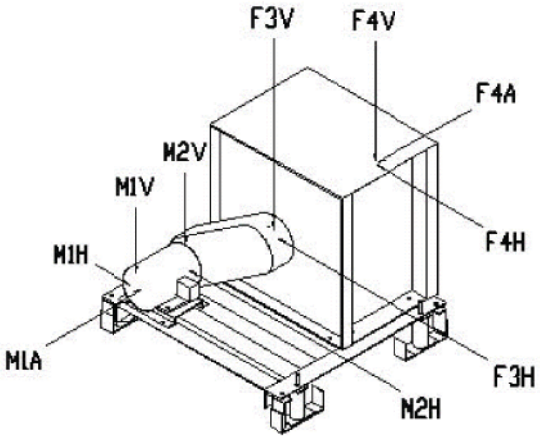
Vibration Readings

Vibration readings shall be taken at fan and motor bearing locations a noted below.







Vibration Report

A factory vibration report shall be provided to all parties involved. It shall be as shown below with a drawing of a representative fan. (Plenum fan vibration report sample below.)

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DRAWING STATUS: Complete

DESIGNER: D.M. /T.R.K.

APPROVED BY: TRK

DATE: 7/22/09

PAGE: 3 of 4

BUFFALO AIR HANDLING

DRAWING NO. (REF. JO#): ES-8107

REV.: C

ES-8107

BUFFALO AIR HANDLING

Vibration Report Plenum

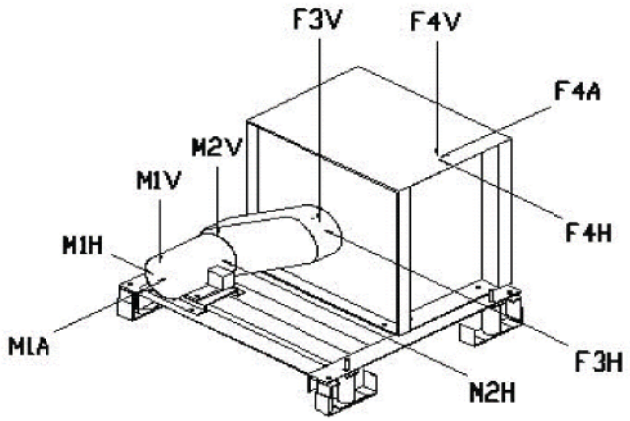
Factory Vibration Test Report:

Shop Order No.: _____
Job Order No.: _____
Customer: _____
End User: _____
Engineer: _____
Mark No.: _____

Number of Fans: _____
Fan RPM: _____
Fan Mounting: _____
Fan Rating: _____
Fan Vibration Limit: _____
Pass/ Fail: _____

Date: _____
Technician: _____

Vibration Instrument: Commtest VB8
Serial Number: _____



Vibration Readings (in/sec):

M1H _____
M1V _____
M1A _____
M2H _____
M2V _____

F3H _____
F3V _____
F4H _____
F4V _____
F4A _____

(Technician Signature, witness test) (Date)

(Witness Signature) (Date)

(Engineering Manager Signature) (Date)

Certified to be Correct

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DRAWING STATUS	DESIGNER:	APPROVED BY:
Complete	D.M. /T.R.K.	TRK
	DATE: 7/22/09	PAGE: 4 of 4

BUFFALO AIR HANDLING

DRAWING NO. (REF. JO#): ES-8107

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